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ART. I.—*Some Observations on the Ethnography and Archæology of the American Aborigines;* by SAMUEL GEORGE MORTON, M. D., Author of the Crania Americana, Crania Ægyptiaca, &c.

NOTHING in the progress of human knowledge is more remarkable than the recent discoveries in American archæology, whether we regard them as monuments of art or as contributions to science. The names of Stephens and Norman will ever stand preëminent for their extraordinary revelations in Mexico and Yucatan; which, added to those previously made by Del Rio, Humboldt, Waldeck and D'Orbigny in these and other parts of our continent, have thrown a bright, yet almost bewildering light, on the former condition of the western world.

Cities have been explored, replete with columns, bas-reliefs, tombs and temples; the works of a comparatively civilized people, who were surrounded by barbarous yet affiliated tribes. Of the builders we know little besides what we gather from their monuments, which remain to astonish the mind and stimulate research. They teach us the value of archæological facts in tracing the primitive condition and cognate relations of the several great branches of the human family; at the same time that they prove to us, with respect to the American race at least, that we have as yet only entered upon the threshold of investigation.

In fact, ethnography and archæology should go hand in hand; and the principal object I have in view in giving publicity to the following too desultory remarks, is to impress on travellers and others who are favorably situated for making observations, the importance of preserving every relic, organic or artificial, that can throw any light on the past and present condition of our native tribes. Objects of this nature have been too often thrown aside as valueless; or kept as mere curiosities, until they were finally lost or become so defaced or broken as to be useless. To render such relics available to science and art, their history and characteristics should be recorded in the periodicals of the day; by which means we shall eventually possess an accumulated mass of facts that will be all-important to future generalization. I grant that this course has been ably pursued by many intelligent writers, and the American Journal of Science is a fruitful depository of such observations.* With every acknowledgment to these praiseworthy efforts, let us urge their active continuance. Time and the progress of civilization are daily effacing the vestiges of our aboriginal race; and whatever can be done to rescue these vestiges from oblivion, must be done quickly.

We call attention in the first place, to two skulls from a mound about three miles from the mouth of Huron river, Ohio. They were obtained by Mr. Charles W. Atwater, and forwarded to Mr. B. Silliman, Jr., through whose kindness they have been placed in my hands. These remains possess the greater interest, because the many articles found with them present no trace of European art; thus confirming the opinion expressed in Mr. Atwater's letter:—"There are a great many mounds in the township of Huron," he observes, "all which appear to have been built a long time previous to the intercourse between the Indians and the white men. I have opened a number of these mounds, and have not discovered any articles manufactured by the latter. A piece of copper from a small mound is the only metal I have yet found."

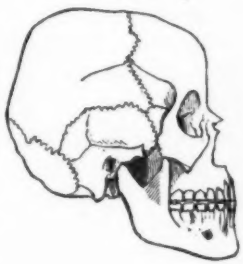
The stone utensils obtained by Mr. Atwater in the present instance, were, as usual, arrow heads, axes, knives for skinning deer, sling-stones, and two spheroidal stones on which I shall offer some

* See more particularly the communications of Mr. R. C. Taylor, in vol. xxxiv, of Mr. S. Taylor, in vol. xxxiv, and of Prof. Forshey in vol. xlix.

remarks in another place. The materials of which these articles are formed, are jasper, quartz, granite stained by copper, and clay slate, all showing that peculiar time-worn polish which such substances acquire by long inhumation.

The two skeletons were of a man and a woman. "They had been buried on the surface of the ground and the earth raised over them. They lay on their backs with their feet to the west." The male cranium presents, in every particular, the characteristics of the American race. The forehead recedes less than usual in these people, but the large size of the jaws, the quadrangular orbits, and the width between the cheek bones, are all remarkably developed; while the rounded head, elevated vertex, vertical occiput and great inter-parietal diameter, (which is no less than 5·7 inches,) render this skull a type of national conformation. (Fig. 1.)

Fig. 1.



The female head possesses the same general character, but is more elongated in the occipital region, and of more delicate proportions throughout.*

Similar in general conformation to these are all the mound and other skulls I have received since the publication of my work on American Crania, viz. five from the country of the Araucos, in Chili, from Dr. Thomas S. Page of Valparaiso; six of ancient Otomies, Tlascalans and Chechemecans, from Don J. Gomez de la Cortina of the city of Mexico; three from near Tampa, in Florida, from Dr. R. S. Holmes, U. S. A.; one from a mound on Blue river, Illinois, from Dr. Brown of St. Louis; and four sent me by Lieut. Meigs, U. S. A., who obtained them from the immediate vicinity of Detroit, in Michigan. To these may be added two others taken from ancient graves near Fort Chartres, in Illinois, by Dr. Wistlizenus of St. Louis; a single cranium from the cemetery of Santiago de Tlatelolco, near the city of Mexico, which I have received through the kindness of the Baron von Gerolt, Prussian minister at Washington; and another very

* We take this occasion to observe, that skulls taken from the mounds, should at once be saturated with a solution of glue or gum, or with any kind of varnish, by which precaution further decomposition is effectually prevented.

old skull from the Indian burying grounds at Guamay, in Northern Peru, for which I am indebted to Dr. Paul Swift. Last but not least, I may add the skull obtained by Mr. Stephens* from a vault at Ticul, a ruined aboriginal city of Yucatan, and some mutilated but interesting fragments brought me from the latter country, by my friend Mr. Norman.†

These crania, together with upwards of four hundred others of nearly sixty tribes and nations, derived from the repositories of the dead in different localities over the whole length and breadth of both Americas, present a conformable and national type of organization, showing the origin of one to be equally the origin of all.

To this prevading cranial type I have already adverted. Even the long-headed Aymaras of Peru, whom, in common with Prof. Tiedemann, I at first thought to present a congenitally different form of head from the nations who surrounded them, are proved, by the recent discoveries of M. Alcide D'Orbigny, to have belonged to the same race as the other Americans, and to owe their singularly elongated crania to a peculiar mode of artificial compression from the earliest infancy.‡

But there is evidence to the same effect, but of more ancient date than any we have yet mentioned. The recent explorations of Dr. Lund in the district of Minas Geraes, in Brazil, have brought to light human bones which he regards as fossil, because they accompany the remains of extinct genera and species of quadrupeds, and have undergone the same mineral changes with the latter. He has found several crania, all of which correspond in form to the present aboriginal type.§

Even the head of the celebrated *Guadaloupe skeleton* forms no exception to the rule. The skeleton itself is well known to be in the British Museum, but wants the cranium, which however is supposed to have been recovered in the one more recently found in Guadaloupe by Mr. L'Hérminier, and brought by him

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* Incidents of Travel in Yucatan, I, p. 281.

† Rambles in Yucatan, p. 217.

‡ L'Homme Americain, Tome I, p. 306. I corrected my error before I had the pleasure of seeing M. D'Orbigny's very interesting work. Amer. Jour. of Science, vol. xxxviii, No. 2. Jour. Acad. Nat. Sciences of Philadelphia, vol. viii; and again in my Distinctive Characteristics of the Aboriginal Race of America, p. 6.

§ See Proceedings of the Acad. of Nat. Sciences of Philadelphia for Dec. 1844.

to Charleston, South Carolina. Dr. Moultrie, who has described this very interesting relic, makes the following observations:—"Compared with the cranium of a Peruvian presented to Prof. Holbrook by Dr. Morton, in the museum of the state of South Carolina, the craniological similarity manifested between them is too striking to permit us to question their national identity. There is in both the same coronal elevation, occipital compression, and lateral protuberance accompanied with frontal depression, which mark the American variety in general."*

There is additional proof of identity, not only of original conformation, but of conventional modification of the form of the head, which I may be excused from reverting to in this place, inasmuch as the materials I shall use have but recently come to my hands. The first of these subjects is represented by the subjoined wood-cut, (fig. 2.) It was politely sent me by Dr. John Houstoun, an intelligent surgeon of the British Navy, with the following memorandum: "From an ancient town called Chiuhiu, or Atacama Baja, on the river Loa, and on the western edge of the desert of Atacama. The bodies are nearly all buried *in the sitting posture*, [the conventional usage of most of the American nations from Patagonia to Canada,] with the hands either placed on each side of the head, or crossed over the breast."†

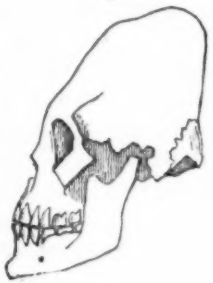
Fig. 2.

* Amer. Jour. of Science, xxxii, p. 364.

† See Proceedings of the Acad. of Nat. Sciences of Phila., vol. ii, p. 274. If I mistake not, I was the first to bring forward this *mode of interment* practiced by our aboriginal nations, as a strong evidence of the unity of the American race. "Thus it is that notwithstanding the diversity of language, customs and intellectual character, we trace this usage throughout both Americas, affording, as we have already stated, collateral evidence of the affiliation of all the American tribes."—Crania Americana, p. 246, and pl. 69. Mr. Bradford in his valuable work, *American Antiquities*, has added some examples of the same kind; and the Chevalier D'Eichthal has also adduced this custom, in connexion with some traces of it in Polynesia, to prove an exotic origin for a part at least of the American race. See *Mémoires de la Société Ethnologique de Paris*, Tome II, p. 236. Whence arose this conventional position of the body in death? This question has been often asked and variously answered. It is obviously an imitation of the attitude which the living Indian habitually assumes when sitting at perfect ease, and which has been naturally transferred to his lifeless remains as a fit emblem of repose.

This cranium (and another received with it) has that remarkable sugar-loaf form which renders them high and broad in front, with a short antero-posterior diameter, both the forehead and occiput bearing evidence of long continued compression. They correspond precisely with the descriptions given by Cieza, Torquemada and others among the earliest travellers in Peru, who saw the natives in various parts of the country with heads rounded precisely in this manner.*

Fig. 3.



The second head figured, (fig. 3,) is that of a Natchez Indian,† obtained from a mound not far from that city by the late Mr. James Tooley, Jr., and by him presented to me. The face in this, as in the former instance, has all the characteristics of the native Indian; and the cranium has undergone precisely the same process of artificial compression, although these tribes were separated from each other by the vast geographical distance of four thousand miles!

Could we discover the cranial remains of the older Mexican nations, we should doubtless find many of them to possess the same fanciful type of conformation;‡ for if either of the skulls figured above could be again clothed in flesh and blood, would we not have restored to us the very heads that are so abundantly sculptured on the monuments of Central America, and so graphically described by Herrera, when he tells us that the people of Yucatan *flattened their heads and foreheads?*

The following diagrams are copied, on an enlarged scale, from Mr. Stephens's Travels,§ and will serve in further illustration of this interesting subject. They are taken from bas-reliefs in the

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* Crania Americana, p. 116.

† I have been looking to Dr. Dickerson, of Natchez, for more complete details derived from the tumuli of that ancient tribe which formed a link between the Mexican nations on the one hand, and the savage hordes on the other. Dr. Dickerson is amply provided with interesting and important materials for this inquiry, which we trust he will soon make public.

‡ The skull brought me from Ticul by Mr. Stephens, is that of a young female. It presents the natural rounded form; which accords with the observation of M. D'Orbigny, (L'Homme Americain,) that the artificial moulding of the head among some tribes of Peruvians was chiefly confined to the men.

§ Travels in Central America, vol. ii, p. 311.

Palace at Palenque. The personage fig. 4, (whose head-dress we have partly omitted,) appears to be a king or chieftain, at whose feet are two suppliants, naked and cross-legged, of whom we copy the one that preserves the most perfect outline, (fig. 5.)

Fig. 4.

Fig. 5.

The principal figure has better features and expression than the other, but their heads are formed on the same model; whence we may infer that if the suppliant is a servant or a slave of the same race with his master, the artificial moulding of the cranium was common to all classes. If, on the other hand, we assume that he is an enemy imploring mercy, we come to the conclusion that the singular custom of which we are speaking, was in use among other and surrounding nations; which latter inference is confirmed by other evidence, that, for example, derived from the Natchez tribe, and the clay effigies so abundantly found at the ruined temples of the sun and moon at Teotihuacan, near the city of Mexico.*

I can aver that sixteen years of almost daily comparisons have only confirmed me in the conclusions announced in my *Crania Americana*, that all the American nations, excepting the Eskimaux, are of one race, and that this race is peculiar and distinct from all others. The first of these propositions may be regarded as an axiom in ethnography; the second still gives rise to a diversity of opinions, of which the most prevalent is that which would merge the American race in the Mongolian.

It has been objected to a common origin for all the American nations, and even for those of Mexico, that their *monuments*

* Crania Americana, p. 146.

should present so great a variety in the configuration of the head and face; a fact which forcibly impresses every one who examines the numerous effigies in baked clay in the collection of the American Philosophical Society; yet they are all made of the same material and by the same national artists. The varieties are indeed endless; and Mr. Norman in his first work, has arrived at a reasonable conclusion, in which we entirely agree with him, "that the people prepared these *penates* according to their respective tastes, and with little reference to any standard or canon."*

They appear to have exercised much ingenuity in this way, blending almost every conceivable type of the human countenance, and associating this again with those of beasts, birds, and various fanciful animals, which last are equal in uncouthness to any productions of the Gothic artists of the middle ages.

Mr. Norman in his late and interesting volume of travels in Cuba and Mexico, discovered in the latter country some remarkable ruins near the town of Panuco, and among them a curious sepulchral effigy. "It was a handsome block or slab of stone, (wider at one end than the other,) measuring seven feet in length, with an average of nearly two and a half feet in width and one foot in thickness. Upon its face was beautifully wrought, in bold relief, the full length figure of a man, in a loose robe with a girdle about his loins, his arms crossed on his breast, his head encased in a close cap or casque, resembling the Roman helmet (as represented in the etchings of Pinelli) without the crest, and his feet and ankles bound with the ties of sandals. The figure is that of a tall muscular man of the finest proportions. The face, in all its features, is of the noblest class of the European or Caucasian race."†

Mr. Norman was himself struck "with the resemblance between this, and the stones that cover the tombs of the Knights Templar in some of the ancient churches of the old world," but he thinks that neither this nor any other circumstance proves this effigy to have been of European origin or of modern date. "The material," he adds, "is the same as that of all the buildings and works of art in this vicinity, and the style and workmanship are those of the great unknown artists of the western hemisphere;"

* Rambles in Yucatan, p. 216.

† Rambles by Land and Water, p. 145.

and he arrives at the conclusion, as many ingenuous minds have done before him, that these and the other archæological remains of Mexico and Yucatan, "are the works of a people who have long since passed away; and not of the races, *or the progenitors of the races*, who inhabited the country at the epoch of the discovery."*

With the highest respect for this intelligent traveller, I am not able to agree with him in his conclusion; but I should not now revive my published opinions or contest his, were it not that some new light appears to me to have dawned on this very question.

In the first place, then, we regard the effigy found near Panuco as probably Caucasian; so does Mr. Norman; but instead of referring it to a very remote antiquity, or to some European occupancy of Mexico long before the Spanish conquest, we will venture to suggest, that even if the town of Panuco was itself older than that event, (of which indeed we have no doubt,) it is consistent with collateral facts to infer, that the Spaniards may have occupied this very town, in common with, or subsequent to, the native inhabitants, and have left this sepulchral monument. That the Spaniards did sometimes practice this joint occupancy, is well known; and that they have, in some instances, left their monuments in places wherein even tradition had almost lost sight of their former sojourn, is susceptible of proof.

Mr. Gregg, in a recent and instructive work on the "Commerce of the Prairies," states the following particulars, which are the more valuable since he had no opinions of his own in reference to the American aborigines, and merely gives the facts as he found them.

Mr. Gregg describes the ruins called *La Gran Quivira*, about 100 miles south of Santa Fé, as larger than the present capital of New Mexico. The architecture of this deserted city is of hewn stone, and there are the remains of aqueducts eight or ten miles in length leading from the neighboring mountains. These ruins "have been supposed to be the remains of a *pueblo* or aboriginal city;" but he adds that the occurrence of the Spanish coat of arms in more than one instance sculptured and painted upon the houses, prevents the adoption of such an opinion; and that traditional report (and tradition only) mentions this as a city that

* Rambles by Land and Water, p. 203.

was sacked and desolated in the Indian insurrection of 1680.* Now had it not been for the occurrence of the heraldic paintings, this city might have been still regarded as of purely Indian origin and occupancy; as might also the analogous ruins of Abo, Tagique and Chilili in the same vicinity; for although these may have been originally constructed by the natives, yet as they are supposed to be near the ancient mines, it is not improbable that the conquerors in these, as in many other instances, drove out the rightful owners, and took possession for themselves;† for that they did possess and inhabit the towns above enumerated is a fact beyond question.

Why may not events of an analogous character have taken place at Panuco? Was it not probably an Indian city into which the Spaniards had intruded themselves, and having left traces of their sojourn, as at *La Gran Quivira*, subsequently, owing to some dire catastrophe, or some new impulse, abandonded it for another and preferable location? This, we suggest, is a reasonable explanation of the presence of the Caucasian effigy found by Mr. Norman among the deserted ruins of Panuco.

Mr. Stephens has, I think, conclusively proved that the past and present Indian races of Mexico were cognate tribes. I had previously arrived at the same conclusion from a different kind of evidence. What was manifest in the physical man is corroborated by his archæological remains. The reiterated testimony of some of the early Spanish travellers, and especially of Bernal Diaz and Herrera, is of the utmost importance to this question; and all that is necessary in the chain of evidence, is some link to connect the demi-civilized nations with the present uncultivated and barbarous tribes. These links have been supplied by Mr. Gregg. Those peculiar dwellings and other structures, with inclined or parapet walls,‡ and with or without windows, which are common to all epochs of Peruvian and Mexican architecture, are constructed and occupied by the Indians of Mexico even at the present day. After describing the general character of these

* Commerce of the Prairies, I, p. 165.

† Ibid. I, 270.

‡ I am aware that the walls of the ancient Mexican and Peruvian edifices are often vertical; but where this is the case the pyramidal form is attained by piling, one on the other, successive tiers of masonry, each receding from the other and leaving a parapet or platform at its base.

modern domicils, Mr. Gregg goes on to observe, that "a very curious feature in these buildings, is that there is most generally no direct communication between the street and the lower rooms, into which they descended from a trap-door from the upper story, the latter being accessible by means of a ladder. Even the entrance at the upper stories is frequently at the roof. This style of building appears to have been adopted for security against their marauding neighbors of the wilder tribes, with whom they were often at war.

"Though this was their most usual style of architecture, there still exists a Pueblo of Taos, composed, for the most part, of but two edifices of very singular structure—one on each side of a creek, and formerly communicating by a bridge. The base story is a mass of near four hundred feet long, a hundred and fifty wide, and divided into numerous apartments, upon which other tiers of rooms are built, one above another, drawn in by regular grades, forming *a pyramidal pile* of fifty or sixty feet high, and comprising some six or eight stories. The outer rooms only seem to be used for dwellings, and are lighted by little windows at the sides, but are entered through trap-doors in the *azoteas* or roofs. Most of the inner apartments are employed as granaries and store-rooms, but a spacious hall in the centre of the mass, known as the *estufa*, is reserved for their secret councils. These two buildings afford habitation, as is said, for over six hundred souls. There is likewise an edifice in the Pueblo of Picuris of the same class, and some of those of Moqui are also said to be similar."*

The Indian city of Santo Domingo, which has an exclusive aboriginal population, is built in the same manner, the material being, as usual, sun-burnt bricks; and my friend Dr. Wm. Gambel informs me, that in a late journey from Santa Fé across the continent to California, he constantly observed an analogous style of building, as well in the dwellings of the present native inhabitants, as in those older and abandoned structures of whose date little or nothing is known.

Who does not see in the builders of these humbler dwellings, the descendants of the architects of Palenque, and Yucatan? The style is the same in both. The same objects have been arrived at by similar modes of construction. The older structures

* Commerce of the Prairies, I, p. 277.

are formed of a better material, generally of hewn stone, and often elaborately ornamented with sculpture. But the absence of all decoration in the modern buildings, is no proof that they have not been erected by people of the same race with those who have left such profusely ornamented monuments in other parts of Mexico; for the ruins of Pueblo Bonito, in the direction of Navajo, and those of the celebrated Casas Grandes on the western Colorado, which were regarded by Clavigero as among the oldest Toltecan remains in Mexico, are destitute of sculpture or other decoration. In fact, these last named ruins appear to date with the primitive wanderings of the cultivated tribes, before they established their seats in Yucatan and Guatimala, and erected those more finished monuments which could only result from the combined efforts of populous communities, acting under the favorable influence of peace and prosperity. Every race has had its center or centers of comparative civilization. The American aborigines had theirs in Peru, Bogota and Mexico. The people, the institutions and the architecture were essentially the same in each, though modified by local wants and conventional usages. Humboldt was forcibly impressed by this archæological identity, for he himself had traced it, with occasional interruptions, over an extent of a thousand leagues; and we now find that it gradually merges itself into the ruder dwellings of the more barbarous tribes; showing, as I have often remarked, that there is, in every respect, a gradual ethnographic transition from these into the temple-builders of every American epoch.*

I shall close this communication by a notice of certain *discoidal stones* occasionally found in the mounds of the United States. Of these relics I possess sixteen, of which all but two were found by my friend Dr. Wm. Blanding, during his long residence in Camden, South Carolina. These disks were accompanied, as usual, by earthern vessels, pipes of baked clay, arrow-heads and other articles, respecting which Dr. Blanding has given me the following locality:—"All the Indian relics, save three or four, which I have sent you, were collected on or near the banks of the Wateree river, Kershaw district, South Carolina; the greater part from the mounds or near the foot of them. All the mounds

* See my Inquiry into the Distinctive Characteristics of the Aboriginal Race of America, 2d edit., Philad. 1844.

that I have observed in this state, excepting these, do not amount to as many as are found on the Wateree within the distance of twenty four miles up and down the river, between Lancaster and Sumpter districts. The lowest down is called Nixon's mound, the highest up, Harrison's."

"The discoidal stones," adds Dr. Blanding, "were found at the foot of the different mounds, not in them. They seemed to be left, where they were no doubt used, on the play grounds."

The disks are from an inch and a half to six inches in diameter, and present some varieties in other respects.

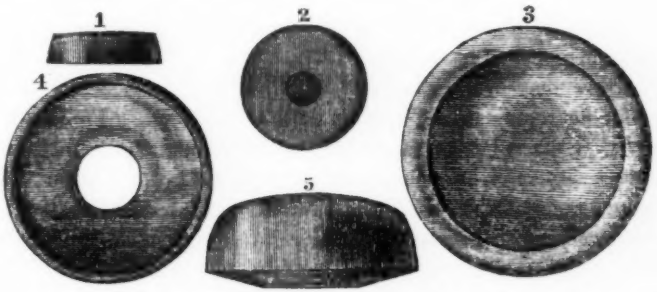


Fig. 1 represents a profile of the simplest form and at the same time the smallest size of these stones, being in diameter about an inch and three quarters. The upper and under surfaces are nearly plane, with angular edges and oblique margin, but without concavity or perforation.

Fig. 2. A similar form, slightly concave on each surface.

Fig. 3. A large disk of white quartz, measuring five inches in diameter and an inch and three fourths in thickness. The margin is rounded, and both surfaces are deeply concave though imperforate.

Fig. 4 is another specimen four inches in diameter, deeply concave from the margin to the center, with a central perforation. The margin itself is slightly convex. The concave surface is marked by two sets of superficial grooved lines, which meet something in the form of a bird-track. This disk is made of a light-brown ferruginous quartz.

Fig. 5 is a profile view of a solid lenticular stone, much more convex on the one side than the other, formed of hard syenitic rock.

Besides these there are other slight modifications of form which it is unnecessary to particularize.

These disks are made of the hardest stones, and wrought with admirable symmetry and polish, surpassing any thing we could readily conceive of in the humbler arts of the present Indian tribes; and the question arises, whether they are not the works of their seemingly extinct progenitors?—of that people of the same race, (but more directly allied to the Toltecans of Mexico,) who appear in former times to have constituted populous and cultivated communities throughout the valley of the Mississippi, and in the southern and western regions towards the gulf of Mexico, and whose last direct and lineal representatives were the ill-fated Natchez?

I have made much inquiry as to the localities of these and analogous remains, but hitherto with little success. I am assured that they have been found in Missouri, perhaps near St. Louis; and in very rare instances in the northern part of Delaware. Dr. Ruggles has sent me the plaster model of a small, perforated, but irregularly formed stone of this kind, taken from an ancient Indian grave at Fall River in Rhode Island; but Dr. Edwin H. Davis, of Chilicothe, in a letter recently received from him, informs me that he had obtained, during his excavations in that vicinity, no less than "two hundred flint disks in a single mound, measuring from three and a half to five inches in diameter, and from half an inch to an inch in thickness, of three different forms, round, oval and triangular." These appear, however, to be of a different construction and designed for some other use than those I have described; and Dr. Davis himself offers the probable suggestion, that "they were rude darts blocked out at the quarries for easy transportation to the Indian towns." The same gentleman speaks of having found other disks formed of a micaceous slate, of a dark color and highly polished. These last appear to correspond more nearly to those we have indicated in the above diagrams.

Besides these disks, I have met with a few spheroidal stones, about three inches in diameter. One of these accompanies the disks from South Carolina, and is marked with a groove to receive the thumb in throwing it. A similar but ruder ball is contained among the articles found by Mr. Atwater in the mound near Huron, Ohio.

What was the use of the disks in question? Those who have examined the series in my possession have offered various explanations; but the only one that seems in any degree plausible, is that of my friend Dr. Blanding, who supposes them to have been used in a game analogous to that of the quoits of the Europeans. It is a curious fact that discoidal stones much resembling these have been found in Scandinavia;* whence I was at first led to suppose it possible, especially in consideration of their apparently circumscribed occurrence in this country, that they might have been introduced here by the Northmen; a conjecture that seems to lose all foundation since these relics have been found as far west as the Mississippi.

Note.—Since the preceding remarks were written, I have received from my friend, Mr. William A. Foster, of Lima, ten skulls and two entire mummied bodies from the Peruvian cemetery at Arica. "This cemetery," observes Mr. Foster, "lies on the face of a sandhill sloping towards the sea. The external surface occupied by these tombs, as far as we explored, I should say was five or six acres. In many of the tombs three or four bodies were found clustered together, always *in the sitting posture*, and wrapped in three or four thicknesses of cloth, with a mat thrown over all."

These crania possess an unusual interest, inasmuch as, with two exceptions, they present the horizontally elongated form, in every degree from its incipient stage to its perfect development.

By what contrivance has the rounded head of the Indian been moulded into this fantastic shape? I have elsewhere† offered some explanations of this subject; but the present series of skulls throws yet more light on it, and enables me to indicate the precise manner in which this singular object has been attained.

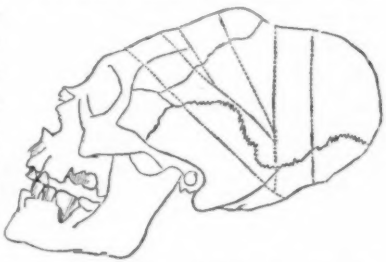
It is evident that the forehead was pressed downwards and backwards by two compresses, (probably a folded cloth,) one on each side of the frontal suture, which was left free; a fact that explains the cause of the ridge, which, in every instance,

* See Journal of the Antiquarian Society of Denmark, published in Copenhagen in the Danish language, vol. i, tab. 2, figs. 52, 53.

† Jour. Acad. Nat. Sciences of Philad., vol. viii.

replaces that suture by extending from the root of the nose to the coronal suture. To keep these compresses in place, a bandage was carried over them from the base of the occiput obliquely forwards; and then, in order to confine the lateral portions of the skull, the same bandage was continued by another turn over the top of the head, immediately behind the coronal suture, and probably with an intervening compress; and the bandaging was repeated over these parts until they were immovably confined in the desired position.

Every one who is acquainted with the pliable condition of the cranial bones at birth, will readily conceive how effectually this apparatus would mould the head in the elongated or cylindrical form; for, while it prevents the forehead from rising, and the sides of the head from expanding, it allows the occipital region an entire freedom of growth; and thus without sensibly diminishing the volume of the brain, merely forces it into a new though unnatural direction, while it preserves, at the same time, a remarkable symmetry of the whole structure. The following outline of one of these skulls, will further illustrate my meaning; merely premising that the course of the bandages is in every instance distinctly marked by a corresponding cavity of the bony structure, excepting on the forehead, where the action of a firm compress has left a plane surface.



This conformation, as we have already observed, was prevalent among the old Aymara tribes which inhabited the shores and islands of the Lake of Titicaca, and whose civilization seems evidently to antedate that of the Inca Peruvians. I was in fact at one time led to consider this form of head as peculiar to, and characteristic of, the former people; but Mr. Foster's extensive observations conclusively prove that it was as common among some tribes of the sea coast, as among those of the mountainous region of Bolivia; that it belonged to no particular nation or tribe; and that it was, in every instance, the result of mechanical compression.

In my Crania Americana I have given abundant instances of a remarkable vertical flattening of the occiput, and irregularity of its sides, among the Inca Peruvians who were buried in the royal cemetery of Pachacamac, near Lima. These heads present no other deviation from the natural form; and even this irregularity I have thought might be accounted for by a careless mode of binding the infant to the simple board, which, among many Indian tribes of both North and South America, is a customary substitute for a cradle. It is probable, however, that even this configuration was intentional, and may have formed a distinctive badge of some particular *caste* of these singular people, among whom a perfectly natural cranium was of extremely rare occurrence.

We are now acquainted with *four* forms of the head among the old Peruvians which were produced by artificial means, viz:

1. The horizontally elongated, or cylindrical form, above described.

2. The conical or sugar-loaf form, represented in the preceding diagrams.

3. The simple flattening or depression of the forehead, causing the rest of the head to expand, both posteriorly and laterally; a practice yet prevalent among the Chenooks and other tribes at the north of the Columbia river, in Oregon.

4. A simple vertical elevation of the occiput, giving the head in most instances a squared and inequilateral form.

A curious decree of the ecclesiastical court of Lima, dated A. D. 1585, and quoted by the late Prof. Blumenbach, alludes to at least four artificial conformations of the head, even then common among the Peruvians, and forbids the practice of them under certain specified penalities. These forms were called in the language of the natives, "Caito, Oma, Opalla, &c.;" and the continuance of them at that period, affords another instance of the tenacity with which the Peruvians clung to the usages of their forefathers.

ART. II.—*On a new process for obtaining Formic Acid, and on the preparation of Aldehyde and Acetic Acid by the use of the Bichromate of Potassa;* by Profs. W. B. ROGERS and R. E. ROGERS of the University of Virginia.

I. *Process for Formic Acid.*

SINCE the important discovery of Döbereiner, that formic acid is evolved from a mixture of tartaric acid, peroxide of manganese and sulphuric acid, the progress of research has shown that in a large proportion of cases, where organic matters are exposed to powerful oxidating agencies, this acid is among the products developed; and hence several other processes have been devised for its preparation, on the large scale and in the laboratory. Of these the one generally in use consists, as is well known, in distilling a mixture in prescribed proportions, of peroxide of manganese, dilute sulphuric acid and starch or sugar.

The inconsiderable amount of acid yielded by this process, and its usually large admixture with other products, especially sulphurous acid, suggested to us, some time ago, the trial of bichromate of potassa, as a substitute for peroxide of manganese, and has since led us to a method of operating, which we think presents decided advantages over that in general use.

When bichromate of potassa, dilute sulphuric acid and sugar are mingled in proper proportions and in a proper order, a large amount of formic acid is developed, of which part passes off during the first violent reaction, and the remainder is separable by gentle distillation. Repeated experiments have convinced us that by mingling all the materials at once, before placing them in the retort, a comparatively small product is obtained, partly from its being volatalized by the high temperature attending the reaction, and partly, we think, because more of the sugar is carried to its highest stage of oxidation in the forms of carbonic acid and water. We have therefore been led to another, and we believe, better mode of operating, of which the following details will serve as an example.

Introducing into a retort, capable of holding about one quart, 800 grains of bichromate of potassa and 10 cubic inches of water, we gently heat the mixture so as to dissolve the larger part of the bichromate. We then add 300 grains of powdered white sugar,

and adjusting to the tubulure a perforated cork and pipette with gum-elastic bag for the gradual introduction of sulphuric acid, we slowly inject about 1 cubic inch of the latter upon the mixture. By regulating the addition of the acid and occasionally intermitting the slender stream, the violent reaction which ensues is prevented from occasioning any very great intumescence. During this stage of the operation, upwards of 2 cubic inches of a clear but feebly acid liquid passes over into the receiver. When the action has in a good measure subsided, we add 5 cubic inches more of water, and apply a gentle lamp heat, continuing the addition of the acid, by allowing it simply to drop from the pipette, until another cubic inch has been introduced. The liquid which now passes over is much stronger in formic acid than in the preceding stage, and the distillation may, without impairing the purity of the product, be continued until about 7 cubic inches have been received. By urging it much beyond this point sulphurous acid will be evolved.

One hundred grains of the liquid thus obtained is capable of saturating about seven grains of dry carbonate of soda. Its purity is such as to fit it for immediate use in illustrating the striking reactions of formic acid and the formiates. Thus—

1. On adding a small portion of it to a solution of nitrate of silver previously curdled by ammonia, and applying heat, the silver is promptly reduced with a lively effervescence of carbonic acid.

2. With a solution of bichloride of mercury, aided by heat, it causes a precipitation of calomel and the evolution of hydrochloric and carbonic acids.

3. Combined with soda it forms a white salt readily carbonized by heat and passing into carbonate.

4. It is not blackened by sulphuric acid, but the soda salt acted upon by this acid evolves carbonic oxide with brisk effervescence.

5. This salt heated with solution of nitrate of silver or nitrate of mercury, precipitates the metal with evolution of carbonic acid.

All these results are so prompt and striking as to evince but little contamination of the formic acid with other products.

On comparing this process with that commonly employed, we are convinced of its superiority, first, on account of the exemption of the product from SO_2, and in a great degree from other

impurities; second, from the much larger amount of formic acid obtained by it from an equal weight of the oxidizing material, sulphuric acid and starch or sugar; and third, from the ease with which the action is controlled.

According to Liebig, (Chem. Org., p. 567,) 10 parts of starch, 37 parts of peroxide of manganese, and 30 parts of sulphuric acid, yield 3·35 parts of an acid liquid, of which 100 grains saturate 15 grains of carbonate of soda. This corresponds to 7·18 parts of liquid such as we obtain. We have thus by the old process 7·18 parts of liquid of equal acidity with our product, while the aggregate weight of the starch, sulphuric acid, and peroxide of manganese is 77. By our process we have about 1800 grains of a similar acid from 2100 grains of sugar, bichromate of potassa and sulphuric acid. In other words, *by the new process, we procure about nine times as much formic acid from the same weight of the three reacting materials, as by that hitherto in use.*

II. *On the preparation of Aldehyde and Acetic Acid by the use of the Bichromate of Potassa.*

In the process described by Liebig, (Chem. Org., p. 378,) and which is the one hitherto generally used for preparing aldehyde in the regular way, the product is obtained from the reaction of peroxide of manganese and sulphuric acid upon dilute alcohol. This operation furnishes a liquid which is so weak in aldehyde, and so mixed with water and formic ethers, and as we have found with acetic acid also, as to present the characteristic reactions only in a feeble degree, and to require two rectifications over chloride of calcium, before it can be used in forming the subacetylite or aldehydite of ammonia.

In the course of some experiments upon the reactions of bichromate of potassa and sulphuric acid upon alcohol, we have been led to a process which affords a larger and much purer product, and which is entirely under the control of the operator. The distinctive features of this method are the substitution of bichromate of potassa for the peroxide of manganese, and the peculiar mode of bringing the reacting materials together. In the use of the bichromate we have since found that we were anticipated by Prof. Kane, who, at page 922 of his Elements of Chemistry, recommends it as a means of obtaining a purer pro-

duct, and specifies briefly the manner in which he conducted the process. As however his method is not noticed in other chemical works, and as our mode of proceeding and some of the results we have obtained, are, we think, not without novelty and interest, we deem them worthy of a brief notice in your Journal.

When alcohol is added to a strong aqueous solution of chromic acid in a retort, a very brisk reaction ensues, and upon applying a gentle heat there passes over a clear liquid, containing a considerable amount of aldehyde, with a faint trace of acetic and probably formic acids. The presence of the aldehyde is readily shown by adding a few drops of the liquid to a solution of nitrate of silver previously curdled by ammonia, and then gently heating the mixture. The oxide is speedily reduced, forming a brilliant metallic coating on the sides of the glass.

Substituting for the chromic acid of this experiment, a mixture of bichromate of potassa and sulphuric acid, and blending with this a quantity of common alcohol, the reaction is extremely violent, a large volume of carbonic acid is evolved, and the liquid which distils over, contains, with other products, *much aldehyde and acetic acid.* To obtain either of these substances but little mingled with the rest, special attention must be paid to the proportions in which the bichromate, sulphuric acid, and alcohol are mixed, and to the order in which they are brought together. Thus, in all our experiments, we found, than when *alcohol* is added *in small quantities at a time* to a mixture of the bichromate and sulphuric acid the distilled product is almost *pure acetic acid*, but when *sulphuric acid* is *slowly dropped* into a mixture of the salt and alcohol, the liquid which passes over contains little else than *aldehyde.*

This remarkable difference in the products is, we think, readily explained by the different intensity of the oxidating power in the two cases. In the former, the alcohol, as it falls into the mixture of bichromate and sulphuric acid, being surrounded on all sides by free chromic acid, is carried rapidly through the lower stages of oxidation, corresponding to aldehyde and aldehydic acid, until by the addition in all of 4 equivalents of oxygen, and the elemination of 2 equivalents of water, it is converted into acetic acid. In the latter case, the sulphuric acid, dropping slowly into

the mixture of alcohol and bichromate, liberates but a small quantity of chromic acid at any one time, and thus limits the oxidation of the alcohol in great part to the first stage, or that of the formation of aldehyde.

From the observation of these facts, we were led, after a number of comparative trials, to the following process for the preparation of aldehyde.

Equal weights of powdered bichromate of potassa and alcohol, sp. gr. 0·842 being placed in a capacious retort, connected with a receiver and the usual means of refrigeration, we adapt to the tubulure a pipette, charged with sulphuric acid, and whose stem reaches nearly to the surface of the liquid, the top of the pipette being furnished with a strong gum-elastic bag for injecting the acid into the mixture beneath. We now slowly add the acid, taking care to avoid excessive reaction, by sometimes allowing it merely to drop spontaneously from the pipette, and again when the action subsides accelerating its flow by pressure. At this period of the operation, the heat evolved in the retort is sufficient to carry over into the receiver a considerable volume of the aldehydic liquid; and, as much carbonic acid is at the same time disengaged, the tubulure of the receiver should only be loosely closed. Having thus added gradually a weight of sulphuric acid equal to about $1\frac{1}{2}$ times that of the bichromate, we apply a gentle lamp heat and continue the distillation as long as the aldehydic liquid passes over. When the reaction is most energetic, white fumes are evolved, which, falling from the beak of the retort into the receiver, are so dense that they may readily be poured from the latter through a funnel into a narrow necked bottle. These, when condensed, form a clear liquid consisting chiefly of aldehyde.

By this process 1500 grains of bichromate of potassa and the same amount of alcohol have on repeated occasions yielded us about 8 cubic inches of a clear liquid, containing but slight traces of acetic acid or other extraneous matters, and possessing all the characters of a nearly pure mixture of aldehyde and water.

The product thus obtained is sufficiently rich in aldehyde to exhibit instantly and strikingly all the characteristic reactions of that substance. It may, therefore, without rectification, be employed in class-room experiments and in testing for silver.

A few drops of this liquid, added in a test tube to a solution of nitrate of silver previously curdled by ammonia, quickly converts the oxide into metallic silver, which attaches itself as a brilliant coating to the glass. In describing this characteristic property of aldehyde, Liebig and others appear to regard the *application of heat* to the mixture as necessary to the effect, (Chem. Org., p. 377.) We have found however that the aldehydic liquid of the above process, as well as the more concentrated aldehyde procured from it by distillation over chloride of calcium, causes a complete and brilliant reduction of the oxide of silver in a few seconds *at ordinary temperature*, and that the same effect results even *when the tube is immersed in snow*, but in this case the change requires two or three minutes for its completion.

Heated with hydrate of potassa the liquid becomes yellow, then of a deep reddish brown color, and in a little while yields floating flakes of the characteristic *resin of aldehyde.*

On adding to the liquid an excess of caustic baryta in the cold, little or no action is manifested; but as soon as heat is applied, the mixture assumes an intense opaque yellow color like that of chromate of lead, which by continuing the heat passes into a deep rich brown, as in the preceding experiment.

The proportion of aldehyde in the liquid as it comes from the receiver in the above process, is such, that to prepare *aldehydite of ammonia*, we may dispense with the two successive distillations from the chloride of lime directed by Leibig, and use the fresh product at once for this purpose. We therefore add to the liquid about half its bulk of sulphuric ether, and pass a stream of ammonia into the mixture. As the aldehyde becomes saturated, the compound in question falls in an abundant deposit of brilliant transparent rhombohedral crystals. From this, as is well known, perfectly pure aldehyde is prepared by the reaction of dilute sulphuric acid.

In some experiments made to determine the delicacy of aldehyde as a test for oxide of silver, we obtained the following results:—

1. A solution of 1 part of nitrate of silver in 1000 of distilled water, when heated gently in a test tube with a drop or two of aldehydite of ammonia, formed a brilliant metallic pellicle on the inner surface of the glass.

2. A solution containing 1 part in 2000 produced the pellicle in distinct spots and not continuous as in the former case. At the same time the liquid became of a deep greenish purple color, and although only one quarter of an inch thick was nearly opaque.

3. A solution of 1 part in 10,000 gave no adherent pellicle, but on continuing the heat for two or three minutes became strongly colored, presenting a deep greenish purple by transmitted, and a dull olive by reflected light.

4. In a solution of 1 part in 20,000, the peculiar greenish purple tint was still quite decided, and even when the solution was diluted so as to contain only $\frac{1}{40000}$th of nitrate of silver this color was very distinctly manifested after heating it sometime with aldehydite. Compared with the faint opalescence caused by the addition of chloride of sodium to the same solution, this effect of the aldehyde appeared to be the more striking of the two.

The peculiar purplish tint of the liquid, remarked in these experiments, is evidently due to the finely divided metallic silver held in suspension, and affords therefore a striking confirmation of the statement of Dupasquier, that not only gold, but silver and other opaque bodies, present this hue when greatly subdivided and viewed through a clear suspending medium, (Comp. Rend., No. 1, July, 1845.) It may be added that the same hue is developed when a very dilute solution of nitrate of silver is subjected to the reducing action of a formiate.

Allusion has already been made to the production of *acetic acid* in large amount by a modification in the above process. For this purpose the powdered bichromate and the sulphuric acid in the proportion of about 2 to 3, are to be first mixed in the retort so as to develop a large amount of free chromic acid. The alcohol is then introduced from the pipette as in the former case and with like precautions. During the violent action that ensues, much acetic acid passes over without the aid of external heat. When the alcohol thus added amounts to about twice the weight of the bichromate employed, the action having subsided, we apply a gentle lamp heat and obtain a large additional quantity of the acid. This we have found to be free from sulphurous acid and to contain little more than a trace of formic acid and aldehyde.

ART. III.—*On the Evidence of Fossil Footprints of a Quadruped allied to the Cheirotherium, in the Coal Strata of Pennsylvania;* by CHARLES LYELL, Esq., F. R. S., F. G. S., &c.

(Communicated by the Author.)

ON my way from Pittsburg to Philadelphia, I visited the rocks in which Dr. King, of Greensburg, first discovered, in 1844, the footmarks supposed to have been made by a large reptile, and which stand out in relief from the lower surface of slabs of sandstone, resting on a thin layer of fine clay. Having visited the quarry and enquired into all the circumstances of the discovery, having seen almost every specimen hitherto obtained, and considered the relations of the sandstone with the rocks lying above and below it, I have no hesitation in declaring my conviction, first, that the footprints are genuine, and were made by a quadruped nearly allied to the Cheirotherium of Europe, if not the same; secondly, that they occur in the middle of the carboniferous formation, having both above and below them seams of coal and strata containing Lepidodendron, Sigillaria, Stigmaria, Calamites, &c.

Great praise is due to Dr. King for the exertions which he has made in bringing these fossils to light, and duly appreciating from the first their extraordinary importance and value. A young man, engaged in an extensive medical practice in a remote town, acting under every discouragement which want of sympathy in those immediately around him, and of access to scientific books or museums could produce, he has persevered and succeeded in forming a fine collection of the fossil tracks, and become acquainted with the relations and organic remains of the contiguous strata.*

I shall begin by describing the first locality to which the attention of Dr. King was called in 1844, a stone quarry about five miles S. E. of Greensburg in Westmoreland county, Pennsylvania. The slabs of argillaceous sandstone are extracted here for paving, but the excavation begun in the bank of a small stream was soon desisted from in consequence of the increasing thickness of the

* Three papers have appeared in this Journal from Dr. King. The first describes and figures the footmarks from five miles S. E. of Greensburg, vol. xlviii, p. 343; the second, those of Derry, vol. xlix, p. 216; and lastly, the supposed hoofed-prints at Connelsville, second series, vol. i, p. 268.

overlying useless shale. Between the slabs of stone, which are a few inches thick, are thin parting layers of a fine unctuous clay well fitted to receive and retain faithful impressions of the feet of animals. About twenty three footsteps have been observed, some more and others less distinct. One of these was seen by Dr. King, to be impressed on the upper surface of a layer of clay, but the specimen was unfortunately left exposed to the weather and destroyed. The other Cheirotherium footsteps stand out in relief from the under surface of a bed of sandstone, and are accompanied by small mud-veins which have been described as fucoids for which they were mistaken. They are in fact casts of those cracks of various sizes which are produced by the drying and shrinking of mud. As the footprints are traversed and occasionally distorted by these veins, it is evident that the shrinkage took place after the animal had walked over the mud. There is every where seen a double row of tracks, which occur in pairs, each pair consisting of a hind and fore foot, and each being at nearly equal distances from the next pair. The toes, on each of these parallel rows, turn, the one set to the right, the other to the left.

The geological position of this sandstone is perfectly clear. It is situated in the midst of the Apalachian coal field, and there is no formation to be seen, except the carboniferous, for a considerable distance in any direction. The beds are gently inclined to the S. E., and occur on the side of one of those troughs which intervene between two anticlinal folds or ridges which are not only found in the principal chain of the Alleghany mountains, but also, as in this instance, in the lower and less hilly country immediately west of the mountains. The sandstone and shale containing the footsteps, crop out from beneath the main or Pittsburg seam of coal, which is about nine feet thick, and has been worked at its outcrop in the immediate neighborhood. This coal is less than a hundred feet above the sandstone, and there are several other seams of workable coal which lie at lower levels; and impressions of Lepidodendron, Sigillaria, Stigmaria, Calamites, ferns, and other carboniferous plants, have been found both above and below the level of these reptilian footsteps.

The second locality which I visited, where the supposed fossil footprints of birds and of quadrupeds resembling dogs, were observed by Dr. King, is situated within a mile of the town of

Derry in Westmoreland county, about fourteen miles north of Greensburg, (see this Journal, vol. xlix, p. 216.) The markings here are all upon the surface of a white coal grit or sandstone, forming a bare ledge of rock, no vegetation, scarcely even any mosses or lichens having grown on the pure quartzose stone. The ledge is about thirty five feet in its longest diameter, and about thirty two in breadth. It projects above the general level about three feet at one end, and slopes down gradually but irregularly till it is only an inch or two high at the lower extremity. There are several other similar but much smaller ledges of bare sandstone within a very short distance, on which there are no footprints. The large ledge is covered with distinct representations, not only of the tracks of birds and dogs, but also of other animals. Those of birds in particular, are cut sharply and deeply, and there is one long series of steps in succession, as if a bird had walked from the lower to the upper end of the ledge, and then over the end, so as to leave on a steep slope inclined to the horizon at an angle of 22°, a clear and vivid imprint. I found it quite impossible to imagine the layers of sand when in a soft state or capable of receiving footprints, to have been ever so placed, as to admit of such an impression being made, and it is obvious that after the loose sand had consolidated and the ledge had acquired its present form by denudation, no bird could have left the slightest trace of its passage over so hard a rock. I may state indeed that I have never seen in Germany, England, or America, any impressions of the tracks of birds or quadrupeds indented on so coarse a sandstone as that of Derry, although casts in relief have frequently been taken in such a matrix, the sand having been poured into the hollows made in the soft mud on which the animals had trodden.

Another serious objection to the supposed geological antiquity of the footprints, presented itself to me on my first view of this ledge near Derry. The impressions are most of them extremely sharp, although the sandstone has not only been exposed for ages to the weather, but evidently acted upon by currents of water, which have shaped out channels and cavities of various depths, and some perfectly round, deep, and regularly formed pot-holes, one of them eighteen inches deep and more than a foot in diameter. I counted on this single ledge no less than nineteen pot holes, between some of which, part of the principal series of bird tracks passes.

Another objection to the genuineness of the footprints, arises from the unevenness of the surface of the rock, on which, as the successive layers lie nearly horizontal (which is shown by sections exhibited in the vertical walls of the pot-holes,) distinct planes of stratification are laid open. The only way of imagining how so great a multitude of tracks could be exposed superficially on many different planes, would be to suppose that each superimposed layer was originally covered with these markings, all the tracks turning in one direction, so that wherever the excavating power of water cut into a subjacent layer, it laid open to view some new tracks. But this hypothesis is so far from being borne out by the facts, that after cutting into the stone in more than twenty places and removing small slabs with imprints upon them, Dr. King has never been able to detect a single indication of a footprint in the rock below.

I have lately seen good imitations of the tracks of birds on a slab of limestone sculptured by Indians, at New Harmony, in the museum of Dr. D. D. Owen. It was brought from St. Louis in the state of Missouri. The different joints of the toes were indicated as in the Derry stone. In the immediate neighborhood of the ledge of Derry there are numerous graves of Indians, and the same place is known to have lain in the line of one of their paths leading from the Alleghany mountains to the west.*

It seems indeed, in the highest degree probable, that the aborigines of North America, whose skill in following the trail of all kinds of game is so well attested, and who are known to have cut in some places on the rocks, rude imitations of the forms of animals, should sometimes have employed, as the symbols of the birds or quadrupeds which they hunted, a copy of these footprints with which they were so familiar. But the true origin of these markings on the Derry sandstone, may, I think, be considered as set at rest by observations lately made in another locality

* The supposed *human footprints* in solid limestone, first discovered and figured by Mr. Schoolcraft in 1822, and considered by him to be genuine fossils, (Am. Jour. Sci., vol. v, p. 223,) will not soon be forgotten. These curious intaglios remained for twenty years unexplained, until Dr. Owen, in 1822, (Amer. Jour. of Science, vol. xliii, p. 14,) demonstrated to the satisfaction of all, their artificial origin, and attributed them (justly no doubt) to the ancient inhabitants of America. We refer the reader to his most interesting paper for a full detail of the evidence, with figures of the acompanying fossils, and some of the instruments which may have been used in the process of sculpture.—*Eds.*

in Fayette county, near Connelsville, (Second Series, vol. i, p. 268,) nineteen miles from Greensburg, and about thirty from Derry.

Dr. King and the Rev. Mr. Hackey have visited this place, and they inform me that on the surface of a hard ledge of sandstone exposed there, some unquestioned Indian hieroglyphics with the representation of two human heads and of a serpent, are to be seen. These are accompanied with tracks of birds and of hoofed quadrupeds, and lastly of a footprint resembling exactly that of a dog or wolf, and identical with some of the most common tracks on the stone at Derry.

I have now only to express my thanks to Dr. King for the assistance which he gave me in prosecuting these inquiries, in which his sole desire was to arrive at the truth, and to correct any mistakes into which he might have fallen. He now agrees with me in regarding those imprints only as genuine and fossil, which occur in Unity township, five miles from Greensburg. They consist, as I before stated, of the tracks of a large reptilian quadruped, in a sandstone in the middle of the carboniferous series, a fact so full of novelty and interest, that when we reflect on its importance, all disappointment in the abandonment of the spurious footprints is forgotten. In no formation have so many excavations affording facilities of palæontological researches in Europe and America been made, as in the carboniferous. No other group of strata has yielded such unequivocal evidence of the presence on the spot, of dry land, or of its existence in the immediate vicinity; and yet here in Pennsylvania, for the first time we meet with evidence of the existence of air-breathing quadrupeds capable of roaming in those forests, where the Sigillaria, Lepidodendron, Caulopteris, Calamites, Ferns, and other plants, flourished. Few geologists will now think it safe to assume, that no other species or genus or even class of terrestrial vertebrata existed at that period.

In conclusion, it may be proper for me to state, that having formerly examined, in company with Prof. Hitchcock, the Ornithichnites of the valley of the Connecticut river, I have by no means been led to doubt the genuineness of those imprints from what I saw at Derry. The fossil markings on the Connecticut are not superficial, but found under circumstances in all respects most strictly analogous to those which have led me to believe in the reality of the Cheirotherium of the coal strata near Greensburg.

Philadelphia, April 26, 1846.

ART. IV.—*Description and Analysis of a new Mineral Species, containing Titanium; with some remarks on the Constitution of Titaniferous Minerals;* by THOMAS S. HUNT of the Laboratory of Yale College.

THIS mineral, which is here described, occurs at Amity, New York, imbedded in a white magnesian limestone, with serpentine, ilmenite, spinelle and chondrodite. In its physical characteristics, it resembles closely Warwickite from the same neighborhood, and indeed the specimen which I have analyzed, was handed to me as a specimen of Warwickite; but its chemical characters and composition differing so much from those obtained for that mineral, I offer it as a new species, and would propose for it, the name of *Enceladite*, after *Enceladus* one of the Titans of ancient mythology.

Mineralogical Description.—Primary form. An oblique rhombic prism. M on M = about 93°: but from the roughness of its faces it is impossible to measure the angles accurately.

Secondary form. The primary with its obtuse lateral edges replaced; the summits of the smaller crystals terminated by imperfect planes and rounded. Cleavage with the longer diagonal, very perfect; brittle; fracture uneven.

Lustre, in the larger crystals glimmering, in the smaller ones resinous, sometimes submetallic on the cleavage surfaces.

Color, iron or bluish black passing into brownish black; streak bluish black.

Hardness 3—4. Specific gravity 3·188.

Chemical Examination.—When heated in a tube it gives off water and assumes a lighter color; if ignited in contact with the air it assumes a brick red. Alone before the blowpipe infusible; with borax it gives a clear bead colored by iron; with salt of phosphorus it gives a globule, orange yellow when hot, which on cooling becomes purplish-gray and opaque.

It is but slowly acted upon by hydrochloric acid, even when aided by heat; but concentrated sulphuric acid readily decomposes it by the assistance of heat, forming a grayish mass.

Qualitative Analysis.—A. A portion of the mineral in fine powder was mixed with sulphuric acid, in a platinum crucible, and covered with a plate of glass; a gentle heat was applied for

half an hour when the color of the mineral had become yellowish-gray. During this operation the glass plate was not sensibly corroded.

B. A *large quantity of water* was now added to the acid mass, when a brownish powder separated, which by renewing the treatment with sulphuric acid became quite white, and was nearly soluble in a solution of carbonate of soda, showing that it was principally silicic acid; this was confirmed by fusing a portion of it with carbonate of soda, and dissolving the fused mass in dilute hydrochloric acid, when flakes of gelatinous silicic acid separated.

C. The solution from B was boiled, when titanic acid was abundantly precipitated. After long ebullition the liquid was filtered, (excluding as much as possible the air,) and by farther concentration reduced to a small bulk; it had a delicate green tint and was found to contain protoxide of iron, with a mere trace of peroxide, which probably arose from a slight absorption of oxygen, and the iron in the mineral was consequently supposed to exist as a protoxide.

D. After peroxidation by nitric acid, the solution was precipitated by ammonia: the filtrate was not affected by sulphuret of ammonium, it gave with oxalate of ammonia, a slight precipitate of lime, but with phosphate of soda and ammonia an abundant one, of phosphate of magnesia and ammonia.

E. The precipitate by ammonia was redissolved by a little dilute sulphuric acid, several crystals of sulphate of potassa were added, and the whole allowed to stand for twelve hours; at the end of this time a large quantity of crystals had formed, which were however completely dissolved by a saturated solution of sulphate of potassa. This showed the absence of cerium and lanthanum, as also of thorium and zirconia. An excess of pure potassa was then added to the solution, the whole digested for some hours and then filtered.

F. The filtrate was neutralized with hydrochloric acid, when carbonate of ammonia gave an abundant precipitate of alumina.

The precipitate by potassa was dissolved in hydrochloric acid, and after being largely diluted and rendered quite neutral, succinate of ammonia was added; the whole was then heated nearly to the boiling point, and as soon as it had cooled, the solution was filtered. These precautions were taken to prevent the pre-

cipitation of yttria, which it was thought might be present; the filtrate was evaporated to a small bulk, feebly acidulated by hydrochloric acid, and oxalic acid was added. This gave no precipitate, even after the lapse of several hours; yttria was therefore absent.

A portion of the mineral was fused with carbonate of soda, and dissolved in hydrochloric acid; sulphuretted hydrogen passed through the solution gave no precipitate, proving the absence of *tin*.

Having determined that the only substances present were silicic and titanic acids, with iron, magnesia, alumina, water and traces of lime, I proceeded to determine their proportions.

Quantitative Analysis.—1. A. One gramme of the mineral previously dried at 250° Fahr. and cooled in a dessiccater, was mixed with sulphuric acid in a platinum crucible; heat was applied and the digestion continued for half an hour; the whole was then allowed to cool, when water being added, a white residue remained. The fluid was carefully decanted off, and more sulphuric acid added, it was then heated till the acid began to be volatilized, cooled and the soluble parts removed by water; this process was repeated five times; the residue, which was silicic acid, weighed = ·185 grammes.

B. The solution was mixed with tartaric acid and ammonia in excess; the iron was then precipitated by sulphuret of ammonium, and when converted into peroxide, it weighed ·130 grammes.

2. A. Five decigrammes of the dried mineral treated as above, gave ·095 grammes; which when treated with carbonate of soda, left a little titanic acid.

B. The solution was precipitated by ammonia and the precipitate redissolved in the smallest quantity of dilute sulphuric acid, the solution being largely diluted with water and boiled for some time, adding water occasionally to supply the loss by evaporation.

It is difficult to precipitate titanic acid by ebullition when the solution contains a large excess of sulphuric acid, but if the quantity of the solvent acid is small, the titanic acid is readily thrown down.

After four hours of ebullition, the solution was filtered and the titanic acid washed with a dilute solution of sulphate of ammonia and ignited; the crust which obstinately adhered to the glass, was removed by a few drops of sulphuric acid, with the aid of

heat, and then thrown down by ammonia. The whole amount of titanic acid after ignition = ·132 grammes.

C. The filtrate was then evaporated to a small bulk, (during which operation no more titanic acid fell,) transferred to a platinum capsule, and digested for some hours with an excess of pure potassa. The mixture was then filtered, and the filtrate being neutralized by hydrochloric acid, carbonate of ammonia was added to precipitate the alumina, which, when ignited, weighed ·0692 grammes.

D. The residue of iron from the potassa solution, was dissolved in hydrochloric acid and precipitated by ammonia; after ignition it weighed ·074 grammes. The excess of weight over that of the iron previously obtained, (= ·018 grammes,) was owing to a little titanic acid not precipitated by boiling, and must consequently be added to the weight of the acid obtained.

E. The ammonical filtrate from B was treated with oxalate of ammonia, a precipitate of oxalate of lime fell, which was converted into sulphate, and was equal to ·013 grammes of pure lime.

F. The filtrate from E, was concentrated and mixed with phosphate of soda and ammonia, after twelve hours the granular precipitate was collected, washed with water containing a little ammonia, dried and ignited; it weighed ·303 grs. = ·111 grammes of magnesia.

G. The water was determined by heating to whiteness, in a covered crucible, three decigrammes of the carefully dried powder of the mineral. The loss was equal to 7·35 per cent.

We thus obtain from 100 parts—

Silicic acid, ...	18·5
Titanic acid, ...	28·2
Protoxide of iron, ...	10·59
Magnesia, ...	22·2
Alumina, ...	13·84
Lime, ...	1·3
Water, ...	7·35
	101·98

Henri Rose in a late memoir* has made it probable that the titaniferous irons contain a titanic oxide (Ti_2O_3) analogous to the

* Annal. de Chim. et de Phys., tome xv, Nov. 1845, p. 290.

sesqui-oxide of tin, and isomorphous with the peroxide of iron; and the same view is advocated by von Kobell.* This oxide is the blue compound which is formed when we digest a solution of titanic in hydrochloric acid with metallic copper; it forms a blue solution from which the oxide is precipitated by ammonia or carbonate of lime as a bluish black substance, which rapidly absorbs oxygen and becomes titanic acid.

It is however difficult to prove the existence of this oxide in titanic iron by actual experiment, as it is found that if we boil the blue solution of the sesqui-oxide or rather the sesqui-chloride, with per-chloride of iron, the iron becomes reduced to the state of proto-chloride, while the titanic oxide is converted into titanic acid. A similar reaction may be supposed to take place in the solution of the mineral, and hence we obtain as the result, titanic acid and protoxide of iron.

This theory of the composition of titaniferous iron, is the only one which satisfactorily explains its isomorphism with specular iron. Mosander ingeniously suggested in explanation of this fact, that a titanate of iron ($Ti\ O_2\ Fe\ O$) existed in these minerals, which was isomorphous with peroxide of iron, but we know of no instance of isomorphism between two bodies, one a salt and the other a simple oxide. If however we admit the existence of this titanic oxide, it can from its isomorphism, crystallize with any proportion of peroxide of iron.

I would suggest that the titanium in this mineral, exists in the form of titanic oxide, and the following reaction seems to favor this view. In an attempted analysis, a portion of the powdered mineral was mixed with sulphuric acid in a small flask, and digested for some time at a gentle heat; the mixture formed a solid crust on the upper part, but on the under surface next to the glass, a *beautiful ultramarine blue tint appeared*, which however disappeared on the addition of water. It was I think due to the presence of oxide of titanium, and did not the scarcity of the mineral forbid, I would make more extended experiments, to determine with certainty the nature of this curious reaction.

Admitting that this is the state of the titanium in this mineral, and that the iron consequently is a peroxide, we have for its composition:

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* Annal. de Chim. et de Phys., tome xv, Nov. 1845, p. 321.

Silicic acid,	18·5
Peroxide of iron,	13·0
Titanic oxide,	25·156
Alumina,	13·84
Magnesia,	22.2
Lime,	1·3
Water,	7·35
	101·346

Which proportions correspond closely to

Silicic acid,	8 equiv.	8		1
Peroxide of iron,	3 "	}		
Oxide of titanium,	7 "	} =16	or	2
Alumina,	6 "	}		
Magnesia,	23 "	} =24		3
Lime,	1 "	}		
Water,	16 "	16		2

In determining the chemical formula for this mineral, it is probable that we must regard the oxides of iron, aluminum and titanium, united, (as isomorphous bodies are known to be,) in quantities which are not necessarily in the ratio of their equivalents. It will be seen that the numbers 3, 7, and 6 do not accurately express the equivalents of their respective substances, but the excess in one is precisely made up by the deficiency of another, so that the sum of their equivalents is just 16; or dividing all the numbers obtained by 8, it equals two equivalents. The formula derived from this is, $2(\ddot{\mathbf{F}}\mathrm{e}\ \ddot{\mathbf{T}}\mathrm{i}\ \ddot{\mathbf{A}}\mathrm{l})+\dot{\mathrm{M}}\mathrm{g}_3\ \ddot{\mathrm{S}}\mathrm{i}+2\dot{\mathrm{H}}$. The small quantity of lime doubtless replaces a portion of the magnesia. The following result was obtained by calculating the quantity of two equivalents of the oxides mixed in the proportion in which they really occur.

	Calculated.	Found.
Silicic acid,	18·000	18.500
Oxide of titanium, Oxide of iron, Alumina,	51·810	51·996
Magnesia,	23·115	22·200
Lime,	1·360	1·300
Water,	6·813	7.350
	101·138	101·346

This mineral is interesting as differing very much from every titaniferous mineral hitherto analyzed, in containing water. This fact connected with the presence of a silicate of magnesia, suggests the idea that it is an altered mineral, which finds additional support from its locality and associated minerals. The magnesian limestone in which it occurs, often contains crystals having the forms of spinelle and pyroxene, but converted into a soft hydrous mineral resembling steatite, a change which has evidently resulted from the introduction of a silicate of magnesia with water. If the mineral under consideration was originally a compound of oxides of titanium and iron with perhaps alumina, we should expect the form of the crystal to be a rhomboid like that of *specular iron* or *ilmenite*. Our present knowledge of the laws of pseudomorphism, appears inadequate to the decision of this question.

Yale College Laboratory February, 1846.

ART. V.—*Observations on the Geology of a part of East Florida, with a Catalogue of Recent Shells of the Coast;* by T. A. CONRAD.

HAVING devoted some attention to the Tertiary formations of the Atlantic coast, I have endeavored to ascertain their relation to European formations. With regard to the Eocene of particular localities, no difficulty was experienced, because all the species of shells were extinct, and yet no Cretaceous forms or characteristic genera, such as Baculites, Hamites, &c., occurred in those places. This fact alone was sufficient to indicate the Eocene origin of the strata in question, but when such shells as Cardita planicosta, Corbis lamellosa, Ostrea bellovacina, and others equally characteristic of the European Eocene, were found in company with many species having a close affinity with shells of the Paris basin, the evidence was perfectly conclusive. The upper series of Tertiary strata, I have ever regarded as equivalent in stratagraphical position, to that portion of the English crag which contains Voluta Lamberti and Isocardia rustica, and whilst that formation was referred to the Older Pliocene, the term was used to distinguish the American equivalent. The error was one of terms alone, and has long

since been corrected. I have explored the shores of the Gulf of Mexico, and employed the lead to procure the small species living in deep water, to compare the existing fauna with that of the Miocene period, and the result is that of three hundred and forty seven species, about forty seven are yet living, making about fourteen per cent. of recent species of shells; this accords with European Miocene strata sufficiently near in the per-centage of existing testacea, so far as such evidence is available, to establish a synchronous origin. This conclusion is confirmed by the close resemblance of the two groups of fossils, though the species are generally distinct. A considerable number of identical forms will no doubt be discovered when our collections shall be more complete. I have a small Corbula from Dax, which cannot be distinguished from C. inequale, Say, of the Virginia Miocene, and even this evidence of contemporaneous deposition, slight as it may seem, has force and interest for any one who carefully compares the fossils of remote formations.

With these introductory remarks, I proceed to give a slight sketch of an expedition to Florida in the winter of 1842, made in reference to new observations on Tertiary formations. A surveying expedition under Capt. Powel having been ordered by the Secretary of the Navy, Mr. Upsher, I was kindly permitted to join the steamer Poinsett, destined for the survey of Tampa bay. It was through the interest of members of the National Institute that I went on behalf of the Society, in order to furnish its cabinet with specimens of the rocks, fossils, and recent shells of Florida. As I have not yet had access to the specimens I sent the Institution, my slight sketch of Tampa bay and the Florida Keys is more imperfect than it would otherwise be. Supplementary observations will, however, in future be published, with a list of such fossils as I found on the Keys. In an expedition of this kind, too little time is afforded to study any one locality thoroughly, but the many points at which we landed, afforded a good opportunity, seldom enjoyed, of observing the geographical distribution of the more common species of shells inhabiting the northern coast of the Gulf. During a stay of three months upon the Florida coast, those species only were obtained which can be identified with supposed extinct forms of the Miocene period. The per-centage therefore of the recent shells of that era is

scarcely modified by these new researches, and it is not likely that it will be by future explorers.

The first point at which I commenced my observations, was at Savannah, the site of which, was once an arm of the sea or bay, flowing over the land which now constitutes the extensive rice plantations bordering the river. This submergence was in the Post-pliocene period and the evidence is derived from shells, of recent species, some of which have been thrown out of the sandy bed of the canal near its junction with the river. These consist of estuary shells, common in all the brackish waters of the southern states, and which are indicated in the following list: *Littorina irrorata*, Say; *Solecurtus caribæus*, Lam.; *Cyrena carolinensis*, Bosc; and *Ostrea virginiana*, Gmel. A bed of the latter with the Cyrena intermixed occurs a few feet above the level of high tide. The water at Savannah is fresh and none of the foregoing species live therein. Several species of Unios occur in the river and canal; the most common are *U. Blandingianus*, Lea, which is probably a variety of *U. carolinensis*, Bosc; *U. subinflatus*, Con.; and *U. Shepherdianus*, Lea.

In ascending St. Johns river, Florida, we passed a bluff on the right bank, about twenty feet high, in which appeared, a thin, very much undulated bed of shells, which proved to be a stratum of *Ostrea virginiana*, as I ascertained by a subsequent hasty visit to the spot. It was at an elevation of ten or fifteen feet above high tide. This Post-pliocene deposit, taken in connexion with those of similar age on Tampa Bay, prove a considerable elevation of the whole Florida peninsula in the Post-pliocene period, a movement which clearly has raised all the Florida Keys above water. The steamer having been beached to repair damages received on St. Johns bar, I had ample time to collect the shells near the village of Hasard a short distance above the sea. There is here a gently sloping sandy beach not rich in shells, which are few in number both of specimen and species. The most abundant shell is *Mactra lateralis*, Say, which inhabits the whole coast from this point to Massachusetts, and is also common on the Keys at Tampa bay. It is also very numerous in the Post-pliocene of Maryland and North Carolina, and occurs more rarely in the Miocene of Virginia. The species near the mouth of St. Johns river are as follows:—

Bivalves.
Ostrea virginiana.
Pinna ———.*
Mytilus edulis.
——— cubitus *Say.*
Tellina lateralis, *Say.*
Amphidesma equalis, *Say.*
Mactra lateralis, *Say.*
Solecurtus caribæus.
Arca pexata, *Say.*
A. incongrua, *Say.*
A. ponderosa, *Say.*
Donax variabilis, *Say.*
Cardium magnum.
Lucina divaricata.
Petricola dactylus.

Univalves.
Ranella caudata, *Say.*
Crytostoma perspectiva, *Say.*
Crepidula plana, *Say.*
Littorina irrorata, *Say.*
Oliva litterata.
Fulgur carica.
F. canaliculata.
Natica duplicata?

All of these, except *Fulgur carica* and *Solecurtus caribæus*, I found subsequently at Tampa bay.

About half a mile from the river, I observed sand hillocks covered with bleached oyster shells, among which I found some specimens of *Arca pexata*, and a water worm *Gnathodon truncatus*. This is a marine Post-pliocene deposit, which corresponds with the estuary bed of Ostrea virginiana alluded to as occuring in the bank of St. Johns river. The living Gnathodon I was unable to find here, and I am persuaded does not exist in this part of Florida.

One of our officers landing at Fort Lauderdate, found a specimen of *Tellina radiata*. I presume this is about the northern limits of this beautiful but common bivalve.

Having landed at Key Biscayne to take in water, I had time for a short walk, during which I observed myriads of the *Polygyra plicata*, Say, in most places near the beach.

On Indian Key I was first made acquainted with the geological structure of this chain of small islands, which border the eastern and southern coast of the Florida peninsula. This island contains only eleven acres, and is composed of a Post-pliocene limestone, which in places seems little more than a cement for myriads of shells of such species as live in the waters of this latitude, and which are generally identical with those of Cuba. The rock on many parts of the shore is hard and full of large cavities, which are lined with four species of Nerita,† and myriads of *Littorina muricata* traverse the bare rocks far above the limit of

* A spinous species common in Tampa bay.
† *N. peloronta*, *N. tessellata*, *N. versicolor*, and *N. pica*.

tide water. Within a short distance is a much larger island and more elevated, with a dense forest except a narrow strip of cleared land which extends quite across the key, (here about half a mile in width,) planted with orange, lime, and other fruit trees. I found here the *Succinea avara*, Say; *Polygyra plicata*, *P. septemvolva*, and *Achatina fasciata*. Along the shore I observed *Spirula Peronii*, *Janthina fragilis*, *Carditomera floridana*, &c. Among the fossils, I found *Lucina tigrina*, *Strombus pugillus*, &c., and as I have not the specimens at present to refer to, I am compelled to defer my list of the Post-pliocene shells of the Keys.

These Keys are numerous, all having a similar origin and differ only in size and shape. They are situated in some of the most beautiful sheets of water that adorn the shores of any continent. Around Indian Key the different colors of the shoals were depicted on the surface of the unruffled water, and the tints heightened by the rays of the declining sun, were inconceivably beautiful. This halcyon sea is bordered by a long line of coral reef, and is navigable for small vessels; but in places the intricate channel demands a skillful pilot. The Poinsett by some accident got out of her course and grounded on a coral bank. We had been some time running in water so shoal that the bottom was distinctly visible, and when we struck I observed variously colored *Gorgonias* and white *Madrepores* which strongly reminded me of a flower garden, beneath the clear water of this shallow sea. The weather was beautiful, and the novelty of the scene united to its extreme lovliness made an indelible impression on my mind. I have no doubt the islands all rest on coral reefs, and their elevation above the sea is due to the movement which has raised the Post-pliocene of the peninsula.

Key West, one of the largest of the group, is a well known spot. Cocoa nut trees grow in the streets of the village, back of which seems to be an interminable forest. A variety of sponges line the beach, and many of the shells of Cuba occur here. East of the town in the shallow cavities of the rock, I found *Fasciolaria tulipa*, *Nerita peloronta*, and abundance of *Fusus corona*, Lam., some in the water and others in the moist limy earth, which in places covers the rocks. West of the town is a sand-beach, no rock appearing, and upon this several forms of cup-shaped and other sponges are very abundant.

Strombus gigas is common here, but it is not found so far north as Tampa bay.

Leaving Key West we soon arrived at Tampa bay on the western side of the peninsula, and here the surveying duties of the expedition commenced. We visited frequently many of the Keys which stretched across the mouth of Tampa bay, and several points on both sides of the bay, and in every locality I collected all the species of shells I could find, in order to study their geographical distribution. The shells are not generally very abundant on the island beaches, but on Mullet Key, whose eastern shore faces the bay, there is an immense accumulation of bivalves, about four feet in depth, the decaying animals of which render the atmosphere quite offensive. The most abundant shell is *Ninus cancellata*, Lam., which has generally both valves united, and the whole deposit is remarkably like that of a pliocene formation. Near this shore is the principal entrance to Tampa bay. On the northern beach of this island, I found *Chama arcinella* and *Strombus pugillus* far more numerous than any where else. While on Mullet Key we find so many bivalves entire, on Palm Key, a long island the most southern of the group, there is a very wide beach seaward upon which are comparatively very few shells and in bad condition. On the bay side the shells are more numerous, water-worn, and with separated valves. The most abundant shell is a species of Mactra like the *M. solidissima* but smaller. Passage Key has a similar group of shells. On North Passage Key immense numbers of small testaceous fragments line the beach.

On Egmont Key I found a solitary specimen of *Natica canrena*. *Pecten dislocatus* is very abundant here. Nearly all the bivalves are disunited at the hinge and water-worn; the surf rolls in a quick succession of waves, which soon injures such shells as may be cast ashore alive.

The shores of Tampa bay present a range of level land, densely wooded with pitch pine and the usual undergrowth of palmettos, but rarely a live oak or other tree of great size. Frequent clumps of mangroves are seen, with their dark green foliage and rugged irregular trunks and roots, the front rank standing in the water, generally dead and picturesque in appearance. High-water mark is defined by a line of sea-weed and other marine substances. Under this mass of vegetable matter, numerous small shells of vari-

ous genera may be collected. We observe here several of the common bivalves which live as far north as Massachusetts. Beds of Modiola demissa are planted about the Mangrove roots; Cardium Mortoni is profusely scattered over the flat muddy shore; Osteodesma hyalina is not uncommon; Pecten concentricus, Anomia ephippium, Balanus ovularis and some other northern shells abound here; but the greater proportion of species are limited to the southern coasts of the Union. Along the water's margin at low tide, the beautiful little Marginella conoidalis crawls slowly upon the surface of the mud. It is accompanied by a far more abundant univalve, Nassa vilrx of Say, which appears in constant motion, like its neighbor. Upon the flat muddy shore, which has a great breadth when the tide is out, live great numbers of that beautiful coronated univalve, named Murex corona by Linnæus, which also seems very partial to oyster beds, and preys upon the animal of Ostrea virginiana. I found here a rare variety of the shell with a double row of spines. The character of this species seemed to me such as would place it in the genus Melongena of Sowerby; most certainly it is not generically the same with Fusus, Pyrula, or Murex to all of which it has been referred by authors. The most noticeable shells on these flats, are the gigantic Fasciolaria trapezium, Fulgur perversus, and F. pyrum. On the bars, nearly exposed at low tide, are beds of spinous Pinnæ and a gigantic species of Venus,* (V. Mortoni,) the shell of which weighs four pounds. Many specimens of Limulus polyphemus are scattered along shore. This crustacean has a wide range, as it inhabits nearly the whole Atlantic coast of the Union. On the grass, bushes and mangrove trees, as high as one can reach, great numbers of the elegant Littorina angulifera live and feed upon the leaves. Many of the shells of the bay shores seem to be confined to the bay, as I never observed them on the sea beaches of the Keys, and yet some of these species inhabit Long Island Sound and the waters about Newport and Boston. It would be interesting could we discover which locality was first colonized by such species, but we know not any clue to information of this kind.

The soil around Tampa bay is sandy and barren, filled with the projecting thick roots of palmettos, and not worth the labor

* V. mercenaria does not inhabit the waters of Florida.

of clearing for cultivation. Rocks are visible in only a few places, the principal of which is Ballast Point near Fort Brooke, at the head of the bay. This point has been much resorted to for procuring chalcedony of unusual beauty, formerly very abundant, but fine specimens are now rare. It coats masses of coral, a species of *Astrea;* which are derived from a Tertiary limestone, rising on the shore a few feet above high tide, and containing many casts of bivalve shells and much silicified coral, which when broken exhibits a cavernous interior lined with chalcedony and sometimes with quartz crystals. Masses of chert are also very abundant in this rock; it contains casts and shells of bivalves and univalves, differing from any I have observed in other rocks. They appear to be extinct species, and are, I believe, referrible to the Eocene period; most probably to an upper division of that formation. I traced this rock to the Falls of Hillsborough river, nine miles above Tampa. It is here very full of casts and impressions of shells of species unknown to me. It forms the basis in this vicinity of the pine and hammock lands, and from the large admixture of fragments of the rock* with the soil, and the many masses of silicified coral scattered over the ground, it is evident that the surface is nothing more than the disintegrated rock with just enough vegetable matter to nourish the trees and plants which grow thereon. In this spot, where there is so much lime in the soil, the pines are very lofty. There seems to the eye very little difference between the hammock and pine soils, both being light, sandy and unproductive. The poverty of the best fields I observed here is scarcely redeemed by the salubrity of the climate. On the Manatee river which enters Tampa bay on the southeast near its junction with the Gulf of Mexico, there is a range of hammock land about fifteen miles long. The settlers here have a good opinion of the soil and propose to cultivate sugar and tobacco. These hammocks depend upon the presence of the Florida limestone, which is certain to be the basis of the soil where live oaks grow, except in limited localities along the shores of bays and rivers where the Post-pliocene formation of shells affords the lime which seems necessary to the growth of that tree in this region of barren soils. Of this formation there are two bluffs on the bay near Sarasota Point, as it is termed,

* I found here an extinct species of Bulimus; B. floridanus, Con.

which is a low sandy and narrow peninsula, forming the southern cape at the entrance of Manatee river. The bluffs alluded to present two short sections about fifteen or twenty feet high, and consist chiefly of beds of shells, some of which are water-worn and broken, and many retain much of their original color and markings. The shells lie in groups of species, in a kind of indistinct stratification. Many of them are water-worn, others broken, and the bivalves occur in separated valves. Bones of the *Manatus* are occasionally found in the bluff, and the living animal is not uncommon in the Manatee river. The shells of this deposit are as follows:—

Bivalves.
Modiola demissa.
Cytherea gigantea.
Pecten concentricus.
Cardium isocardia.
Ostrea virginiana.

Univalves.
Fasciolaria trapezium.
F. tulipa.
Fasciolaria distans.
Natica duplicata.
Murex ——, *Lam.* A recent species occuring on Mullet Key.
Strombus pugillus.
Melongena corona. (Fusus, *Lam.*)
Fulgur pyrum.
F. perversus.

The most abundant of these are *Pecten concentricus*, *Ostrea virginiana*, *Fulgur perversus*, *F. pyrum*, *Fasciolaria tulipa*, *F. distans*, and *Strombus pugillus*. The group is precisely the same with that now living in the water in the immediate vicinity, though the small shells which abound in the bay I did not observe among the fossils. The vicinity of Sarasota Point is very interesting to a geologist, in consequence of the presence of several mounds of shells, much resembling those of artificial construction, and which would deceive any unpractised eye. On examination, the structure of the mounds is too similar to that of the bluffs already described to indicate a dissimilar origin, although no doubt many of the loose shells scattered around were cast there by Indians, as this must have been a favorite haunt where fresh-water fish and oysters could all be obtained in great abundance. But the Indians, to procure the animal of the large "conchs," must have burnt or broken the shells, which in the interior of the mounds present no traces of injury or fracture, though they are often water-worn, and when this is the case they must have been dead shells deposited in the ancient waters of the bay. These mounds occur on the river just above Sarasota Point, in the vicinity of a large spring of dark colored water, about fifty

yards from the shore, which is shaded by a live oak. Around, are large conch shells thrown into small heaps by Indians. A few acres are cleared in the vicinity, and a nursery of orange trees planted. The rest is pine forest with the usual undergrowth of palmetto. A short distance up the river there is a bed of Post-pliocene oyster shells, about eight feet above the level of high tide, and above these fossils a few live oaks grow. At the head of Old Tampa bay the shore rises abruptly in rounded hills, one of which is comparatively large, and they are all covered with live oaks and a profusion of vines. These hillocks are of the same geological character with those of Manatee, composed of shells with a sandy soil above them. On the shore I observed masses of accreted sand with oyster shells, and very perfect casts of the same, quite indurated. There is also a Post-pliocene bed of this species over the limestone at Ballast Point; and at Fort Brooke there is another deposit of shells of the same age, but consisting of estuary species, such as live in the entrance of Hillsborough river; the group is chiefly composed of *Cyrena carolinensis*, *Ostrea virginiana*, *Gnathodon truncatus*, *Fusus corona*, *Natica duplicata*, and *Neritina reclivata*, (Theodoxus, Say.) A limestone, apparently identical with the rock at Ballast Point and Hillsborough Falls, occurs a few miles up Manatee river in the bed of a rivulet. It is silicious and hard in places; sometimes friable and sandy. In it I have observed casts of bivalves, none of which seem to agree with recent species of North America. Of its range and extent I am ignorant, having seen it only in this spot. It is near the shore of a creek, having a very narrow entrance, but which widens above, and about one mile and a half up, contracts again; then expands into a beautiful basin, with tables of rock bordering the shore. This rock is fragmentary, hard, and contains pebbles and limestone concretions, shells, corals and sharks' teeth, and is much honey-combed by the water. I observed several specimens of an unknown *Pecten* imbedded in it. Above this is a buff colored limestone without organic remains, about one foot thick. This spot is the limit of tide water, and in the stream above, I found many specimens of *Neretina reclivata* of unusual size. Young alligators were sporting in the water under the overhanging ledges of the rocks.

At Stony Point on the east coast of Tampa bay are some black, water-worn bones of mammalia, and Capt. Powel found here a

specimen of the large shark's tooth, (*Carcharias megalodon,*) a species occuring also in North Carolina.

One of the most remarkable places near Tampa is a large sulphur spring, eight miles up the Hillsborough river. About one hundred yards up a tributary, the spring boils up and fills a capacious basin. It is white sulphur water coming from the crevices of limestone and from twelve to eighteen feet deep, and so perfectly limpid that the incrustations of sulphur at the bottom are as distinctly visible as if the water were but an inch in depth. Just below the spring great numbers of mullets may be seen scudding in all directions as the boat passes over them, but not a fish of any kind seems to trespass upon the sulphureous basin.

In the fresh water of Manatee river, a large soft-shelled turtle is frequently caught by the settlers who prize it as an article of food. I inquired the number of claws on each foot, and was answered by a man who had recently caught one, that there are five claws to each foot, which verifies the accuracy of Bartram, who describes and figures an unknown species with this character, which must be very distinct from the common soft-shelled tortoise of the south, (Trionyx ferox.)

Since writing the preceding sketch of Tampa bay, I have examined more attentively the casts and shells contained in the limestone. None of these can be identified with any recent shells of Florida or the West Indies. But what has satified me that this rock is geologically older than the Post-pliocene, is the occurrence of an extinct species of land shells, a Bulimus which is silicified and extremely perfect. No similar species of this genus exists in North America. All the other shells in the rock are decidedly of marine origin, and very large masses of a new species of Columnaria abound. It is remarkable that the fossils of this rock have no near resemblance to those either of the Miocene or Eocene, and it will most probably prove to be an upper member of the latter. The local depositions of this formation vary much in their fossil contents. Those of the Santee river in South Carolina, are quite distinct from the group which characterizes the Eocene limestone at St. Stephens, Alabama.

I have obtained casts of a species of Venus; of Nucula, two; Cytherea, one; Natica, one; Bulla, one; Bulimus, one; and two Foraminifera, comprising a Nummulite and a Cristellaria. The latter multilocular shell can be obtained by pounding the rock in-

to small fragments, when the shells fall out entire, and some of them can readily be seen without a glass.

The variations in the groups of shells may be in part owing to some difference in geological age, as the Eocene has unquestionably newer and older members, as well as the Pliocene or other formations. But depositions in different depths of water and on different kinds of bottom have also caused local variations in the fossil contents of Eocene rocks. Much light could be thrown upon this subject by a careful investigation of recent species inhabiting different depths of water along the coast. The Miocene, however, could be still better illustrated by this means, because the deep-water species are precisely those which most abound in the Miocene and are most rarely seen upon the beaches. Thus while sailing in the Gulf of Mexico, I watched with interest such specimens from the bottom as the lead brought up, and by this means I obtained a new Corbula, a specimen of Dentalium coarctatum, which I believe to be the first living one found this side of the Atlantic, although it is a common shell in the Virginia Miocene. I obtained also Cytherea elevata and Nucula acuta, which are likewise common in Miocene deposits. All these are deep-water species, living at the depth of eighteen or twenty fathoms, which I never found recent on the beach, and therefore they may fairly be cited as evidence of the fact that such Miocene localities as contain abundance of them, originated in water of similar depth. Other localities of Miocene contain quite different species, and beds of shoal-water origin can often be clearly made out. With regard to the Eocene, no doubt can be entertained that similar causes have produced similar effects. I hope to make out a line of demarcation between the older and newer strata of the Eocene period that may be convenient in the study of this formation. Thus I propose the Nummulite limestone of St. Stephens and Clark county, Alabama, and the fossilliferous bluff at Claiborne, as Lower Eocene, inasmuch as they hold a few species intimately related to, if not identical with, cretaceous forms, and so far as we know, all the species are extinct. The limestone of Savannah river in Georgia, between Savannah and Shell bluff, contains two recent shells, Lithodomus dactylus and Trochus agglutinans, and is evidently a later deposition than the former rocks. I propose to term this, Upper Eocene, and very probably the prevalent limestone of Florida will be included in this division.

This rock extends throughout the peninsula, as far south at least as Tampa bay; and both the east and west shores of this peninsula are covered with a Pleistocene formation of recent species of shells and remains of mammalia. The elevation of East Florida above the sea level is so inconsiderable, that all or nearly all of it must have been submerged at the time the Post-pliocene species were existing, and therefore its elevation was contemporaneous with that of the Keys, which line its eastern, southern, and western coasts.

ART. VI.—*The Physical Structure of Plants;* by D. P. GARDNER, M. D., formerly Professor of Chemistry and Natural Philosophy in Hampden Sidney College, Virginia.

1. THE composition of the earth's atmosphere is the result of great physical laws, which acting in all places produce an uniformity of structure of the highest interest and importance. Whatever cavities or porous systems lie in this medium are subject to its laws, and the same forces which produce the diffusion of gaseous volumes into the air, govern their penetration throughout membranes. The movement into a cavity, and the escape of aëriform matter come to an end after a time, and there remains a similar atmosphere within, and around the exterior. So true is this that whatever gases are confined in porous bodies, pervious tissues, or fissured vessels, will sooner or later acquire the composition of the common atmosphere.

2. Botanists in studying the phenomena of plants, have hitherto been too much attracted by those of the highest development, in which a complex machinery of spiral vessels, laticiferous ducts, and other additional organs exist. The office of these parts will undoubtedly be resolved in time, but unless we first comprehend the general functions, the uncertainty which now exists in vegetable physiology will remain undispelled. The green mildew of damp walls, *Chlorococcum vulgare*, offers us an instance of an elementary plant, consisting of a single cell, which is nevertheless possessed of all the essential qualities of a vegetable. Within its limited dimensions are stored the forces of growth; the ability to decompose carbonic acid for the production of amylaceous matters—within its one wall the azotized products are formed

and seeds perfected. To enter this organism, gases must penetrate the bounding tissue, and whatever elastic products are formed by chemical decomposition must find exit. But however readily some might admit the porosity of this inferior vegetable, most botanists are disposed to look to a recondite principle, a vitality, for the solution of physiological points. The influence of ordinary penetration in plants has never been proved, although conjectured by Liebig, Dumas, and the more speculative chemists, on the contrary the only direct series of experiments made on the subject by Messrs. Ferrand and Calvert, (Ann. de Chim. &c., August, 1844,) led those gentlemen to the opposite conclusion. They assert, at page 485 of their memoir, that "the bladders of *Colutea arborescens* are not permeable to the air except in the most limited degree." In the case of *Clorococcum* the penetration of gases is not only an essential point but nearly the only physical phenomenon, the other processes of growth and decomposition of carbonic acid, &c., being effects of this in a great degree. Now there is little doubt that the organic forces of this plant are those of the whole vegetable kingdom; hence to prove that the structures of other plants is identical with this, is to show that all are reducible in their essential functions to a system, subject to physical penetration, and this is the object before me. I propose to discuss this position under the following heads:—

1st. The bounding membrane of plants is porous.

2d. The nature of the internal gas of plants.

3d. The action of roots on the gases of the soil fluid.

4th. The absorption of gases by plants is a result of their porosity.

5th. The action of plants upon artificial atmospheres.

I. *The bounding Membrane of Plants is porous.*

3. The object here is to show that the epidermis is not merely capable of transmitting a gas of particular composition, but that it obeys the theoretical requisitions of a porous membrane. This is not indeed asserted of other plants than those employed, although I believe it to be a general law of the vegetable kingdom, the exceptions being inconsiderable. The bounding membrane of leaves is taken for experiment, because there exists no doubt of the free intercommunication within plants by the cellular spaces and other channels, and because it is obvious that if any

vital force or antagonism existed to the operation of the phyisical laws of penetration it would be situated at the threshold; over the exterior and not in the interior of plants.

4. The experiments were planned with the twofold object of showing that carbonic acid would penetrate into a vessel containing common air, notwithstanding the opposition of a barrier of vegetable epidermis, and secondly that an enclosed atmosphere of theoretical composition would solicit the passage of both carbonic acid and oxygen towards it, and at the same time throw out nitrogen gas. There was some difficulty in obtaining perfect specimens of epidermis from most leaves and the observations were limited to those plants which furnished it readily and were accessible.

5. *The experiments.*—August 6th, 1845, a tube five inches long and one third of an inch in bore was selected, and one extremity softened and pressed until it presented a thick ring of glass, this was next ground to a plane surface. This tube was depressed in a mercurial vessel to within an inch of the mouth, a portion of the fresh epidermis of the Madeira vine (*Bassilla lucida*) was then adapted to the ground surface by means of soft wax. The portion of membrane lying over the bore of the tube was circular and nearly a third of an inch in diameter. The tube was now raised up three inches from the trough and suspended by a wire; the membrane sustained the pressure of three inches of mercury without leakage. In about ten minutes sufficient clear limewater was introduced through the column of mercury to reduce its level to that in the vessel, so that the tube contained one inch of atmospheric air at the same pressure as that without, and three inches of limewater, and was closed above by vegetable membrane and below by mercury. Over this arrangement a small bell jar was placed containing atmospheric air with 10 per cent. carbonic acid. The experiment commenced at 1 o'clock P. M., temperature 81° Fah., and at 6 o'clock P. M. the limewater exhibited a distinct pellicle of carbonate of lime.

6. The carbonic acid therefore penetrated the epidermis. This experiment was made with slight modifications with the upper and lower epidermis of the Madeira vine, the epidermis of the cabbage leaf, the *Alanthus alata*, *Chenopodium album*, and several species of Sedum which are covered with a tough skin readily removed. Some leaves, as from the *Impatiens balsamica*,

furnished an epidermis that leaked so fast when the tube was raised from the mercury, that no experiments could be made with them, other specimens sustained for thirty-six hours a pressure of four inches and then became so dry as to crack.

7. August 12th.—A tube similar to the preceding, but with an aperture of one fourth of an inch and graduated, was closed by a piece of the epidermis from the under side of a cabbage leaf. It was filled with mercury, placed over the trough and 400 measures of a mixed gas, containing nitrogen 87, oxygen 13 per cent. introduced; there still remained two and a half inches of mercury. Over this was inverted a jar containing common air with 10 per cent. carbonic acid. The arrangement was completed at 2 P. M., temperature 83° Fah., and the mercurial column descended until 11 o'clock P. M. when the tube contained 433 measures, this remained stationary until 5 P. M. the next day, temperature 81° Fahr. The internal gas yielded on analysis, nitrogen 76, oxygen 17, carbonic acid 7 per cent. Therefore nitrogen had been evolved from the tube and carbonic acid and oxygen absorbed. The external mixture was not examined, as the object in view was merely to ascertain the mechanical penetration. The foregoing plants were also examined in this way and all gave similar results.

8. Variations were made in these two experiments to attain certainty, and the results were uniform when the same membrane was used. There was considerable difference in the rapidity with which gases penetrated the different specimens of epidermis. This fact is no doubt connected with the number and size of the stomata; and in the case of the balsam it was manifest, the epidermis being studded with them: but as this point did not specially occupy my attention I dismiss it without further remark.

II. *The Nature of the internal Gas of Plants.*

9. It having been shown that the bounding membrane is porous, the gases of the interior of the plant should apparently resemble the common atmosphere. But this is true only under one condition, that all chemical changes in the interior shall have been arrested for some time. It is obviously untrue in every case where organic movements are occurring, whereby some gases are absorbed and others decomposed, and this we know to be the condition of a living vegetable.

10. Several observations have been made on the gases contained in the cavities of plants, by Priestly, Davy, Ferrand and Calvert, Payen and others. But in all cases the collections have been in supernumerary organs, or such means have been taken for obtaining the gas as to interfere with the result. The examination has also been made without considering the effects of a porous epidermis, and the internal changes going on in the plants. It is obvious that the internal atmosphere of a permeable body, freely in contact with air, and with the gases of fluids or the soil, and which is moreover an apparatus of decomposition and other chemical actions must be ever fluctuating. The presence of light, its intensity, and the structure of the soil are disturbing causes.

11. Placing before me the above considerations, and the known fact that the gases evolved by growing plants differ in light and darkness, I considered in what way to obtain a knowledge of the *normal* atmosphere of active plants. It is not worthy of thought in investigating this question, whether the internal gases are separated into spiral or laticiferous vessels, or insulated cellules; it is probable there is an inner system of barriers, which in the higher vegetation is necessary to produce particular results, but in the lower classes this is absent, and therefore we might infer that there is a common plant atmosphere as well as a peculiar combination of gases within particular portions. The solution of the problem appears to rest in obtaining the gas diffused throughout plants whilst they are in a vigorous state, some time after the sun has been acting on them, and without mutilating the specimens before use, as nearly every observer has done. The gas of the plant should not be drawn out by the air-pump because the elastic fluids of the sap and of the closed vessels are obtained in this way and these are not sought after.

12. For the purpose of satisfying these conditions, I transplanted in May, 1844, several young plants of *Datura stramonium* and blue grass (*Poa pratensis*) into small tumblers and allowed them to remain three to six weeks before use, so as to be perfectly vigorous. Having completed my arrangements for analyzing minute portions of gas, by means of a sliding-rod eudiometer, I proceeded in the experiments after the following manner. The time of examination was about 11 A. M., after the plants had been fully exposed to bright diffused light, (June.) Two or more specimens being selected, the tumblers were placed in a small

tub containing sufficient water to just cover them and not interfere with the functions of the plants; by moving the water with the hand, it softened and washed out the garden mould of the tumblers, enabling me in a few minutes to remove each plant in a perfect state, without injuring a single spongiole. The plants were next introduced into a suitable pneumatic trough, washed free from adherent air by passing the fingers over every part, and then drawn under a receiver with a wide mouth, where they were rapidly broken and gently pressed so as to obtain the free gases of their interior; the stem and leaves both furnished gas. These manipulations were conducted as rapidly as possible and the gas obtained immediately analyzed.

13. The plan of analysis consisted of first passing the gas through solution of potash in a Kemp's tube, to ascertain the carbonic acid, then mixing with binoxide of nitrogen properly prepared for the occasion, to discover the oxygen, the resulting gas was examined for hydrogen and carburetted hydrogen in several cases but found to be pure nitrogen. The examination was completed in about three minutes, and no corrections for temperature, pressure, or moisture were necessary from the rapidity of the operations, and the whole being conducted in water of the same degree of heat. I confess my unwillingness to use the binoxide, but neither the eudiometers of Volta, Ure, or Hare could be employed with such small amounts of gas, and finally I became reconciled to this method by the excellent results which may be obtained with a little care. Each series of examinations was compared with an analysis of atmospheric air made immediately after, and in 25 measures I find that the average amount of oxygen is 20·83 per cent., from which it never varied 0·20 volumes; this result is equal to that of the elaborate analyses of Dumas and Boussingault, who obtained 20·8 per cent of oxygen.

14. *Experiments.*—Three analyses of the internal gas of the Datura plants, gave on the 15th of June, a mean of nitrogen 87·0, oxygen 13·0 per cent. with no carbonic acid, and on the 17th, three further examinations gave nitrogen 88·0, oxygen 12·0 and no carbonic acid.

Two analyses of the gas from grass plants on the 15th, gave a mean of nitrogen 84·2, oxygen 14·8 per cent., and on the 17th, nitrogen 88·0, oxygen 12·0 without carbonic acid in either case. An analysis by Dr. Draper published in the Philosophical Maga-

zine, of gas obtained from grass by the air-pump, is precisely the same as in the second examination.

15. In these measures we discover a remarkable uniformity not only in the same species but in both plants. The mean of the six examinations with Datura gives an internal atmosphere of nitrogen 87·0, oxygen 12·5 per cent cent., and the four with grass a mean of nitrogen 85·5, oxygen 14·5, or a mean of the whole equal to *nitrogen* 86·75, *oxygen* 13·25. This we therefore assume as the normal or usual plant atmosphere at 11 to 12 A. M., and during vigorous existence in the presence of bright diffused light.

16. It is distinctly to be understood that the above or conditionally normal atmosphere is perpetually changing, and is true only for the time and place. In my preparatory examination of the subject I measured the internal gas of a specimen of grass as nitrogen 84·6, oxygen 13·0, carbonic acid 2·4 per cent., but overlooked at the time the circumstances of the analysis. Messrs. Calvert and Ferrand give, as the composition of the gas in the hollow stems of *Phytolacca decandria at night*, nitrogen 76·4, oxygen 20·6, carbonic acid 3·0 per cent.

III. *The action of Roots on the Gases of the Soil Fluid.*

17. The roots of plants present an absorbent surface which is probably little less than that of the leaves; a knowledge of their action is therefore indispensable to a proper understanding of the physical structure of plants. On this point nothing can be derived from the labors of others except that De Candolle (Physiologie, t. i, p. 248) asserts that uninjured roots exhale no gas either in light or darkness. Theoretically it is admitted by most physiologists that the entrance of fluids into plants by their roots is a process of endosmosis, but in regard to elastic matters we are left to infer that such find entrance as happen to be dissolved in the liquids of the soil, since no direct examination of this point has ever been made.

18. This inference that all the gases dissolved in the soil fluid penetrate into the interior of plants, can only be admitted under limited circumstances. Wherever the sap is already saturated with a given gas, further quantities will not be received; and again, the fluids of the plant may be electrically opposed to the penetration of a particular gas. The absorbent capacity of the

sap is likewise subject to the variations of light and darkness, and of chemical conditions. We cannot therefore reach any certainty by mere argumentation as to the action of roots on gaseous mixtures dissolved in fluids, and must resort to experiment for a solution of the problem. Our researches must also be directed to a given point, as shown in section 11, or we obtain no trustworthy conclusion.

19. *Experiments.*—On the 25th of June, 1844, I commenced a series of observations to determine the action of the uninjured roots of Datura and blue grass on the gases of common pump-water. The plants were obtained as directed in section 12, so that the roots were perfect. Each specimen when washed free from soil was introduced into a vessel of glass, of the figure represented in the engraving, and previously filled with pump-water. By this contrivance the gases evolved by the roots, if any, would rise into the upper part *a*, fresh water could be added to compensate for evaporation by the leaves, and the atmosphere be completely shut out. The plants of Datura were nine inches high, the grass plants about five inches. Three sets of plants were used, two specimens of each being placed in darkness, *A;* in diffused light with the glass uncovered, *B;* and thirdly with the leaves exposed to light but the glass vessel covered, the roots being in darkness, *C*.

20. On the evening of the 25th, the two plants of Datura, *B*, were placed in the study window so as to receive the morning light; at 11 o'clock the next morning there was sufficient gas in both vessels for analysis, (§ 13,) the composition of both was identical—nitrogen 96·9, oxygen 3·4, no carbonic acid. A test experiment with air gave 20·9 oxygen per cent. These two plants being uninjured and exceedingly vigorous were returned to the receiver, supplied with fresh water, and placed in a dark cupboard at 10 P. M. of the 26th, where they remained for thirty-six hours without evolving a bubble of gas. At 10 A. M. of the 27th they were again exposed to light, and yielded at 2 P. M. suf-

ficient gas each for three analyses, the mean of which gave, nitrogen 96·2, oxygen 3·8, without carbonic acid. Atmospheric air at the same time yielded 20·8 per cent. oxygen.

The grass plants *B* yield gas, but usually in such small quantities as to be unserviceable, but two examinations obtained gave, nitrogen 96·0, oxyn 4·0, without carbonic acid.

21. The two Datura plants *C*, with only their leaves illuminated, were exposed at the window on the evening of the 26th, and furnished sufficient gas at 11 o'clock the next morning for six analyses; the gas in both was similar, and gave a mean of nitrogen 96·5, oxygen 3·5 per cent., without carbonic acid.

22. Neither the grasses not Daturas furnished any gas in complete darkness, although the experiments were continued until the specimens were decomposed. We see however that an exposure to darkness for thirty-six hours did not arrest the vigorous action of Datura in section 20.

23. *Deductions.*—The foregoing experiments prove that the perfect roots of plants, so far as these specimens are concerned, appear to evolve gas, but in different amounts, and that the gas consists of nearly pure nitrogen and is very uniform in composition under the same circumstances. The exposure of roots to light or darkness does not seem to influence the result, but the action of light on the leaves is essential to the production of gas.

24. The gas collected in the reservoir was in some measure derived from the sides of the glass and did not appear to be emitted from the root, but was collected in minute bubbles over its fibres. The evolution did not however depend upon the mechanical action of light or heat, for the water in the darkened vessels and some placed for comparison without any plant did not furnish any. The composition of the gas is also opposed to this supposition, for by Prof. Morren's researches, (Ann. de Chim, &c., Sept. 1844,) it is shown that the sun's light liberates carbonic acid and nitrogen, accumulating oxygen in the water, a result very different from what occurred in these cases.

The gas contained in pump-water and separated by boiling, was nitrogen 48·0, oxygen 22·0, carbonic acid 30·0 per cent. The root acting on this mixture disturbed its composition by absorbing the carbonic acid and most of the oxygen present, hence causing the water to abandon the nitrogen for which it has but a feeble affinity. Therefore we may conceive that every cubic millimeter of pump-water absorbed, gave up its nitrogen as an elastic

body instead of carrying it into the sap of the plant; the gas thus liberated being nearly insoluble in the remaining fluid, rose through it into the upper part of the receiver. It is even probable that the roots gave off no gas whatever from the sap.

25. The experiments show that plants do not merely absorb the gases dissolved in water, as is usually imagined, but that their action is regulated by internal functions, for during night or darkness, the water, with its gaseous contents undisturbed, is absorbed, but during the active condition of vegetation a selection is made of carbonic acid chiefly, and that oxygen is also absorbed, whereas in all probability every molecule of nitrogen is rejected.

IV. *The absorption of Gases by Plants is a result of their porosity.*

26. We are now in possession of sufficient data to state the case. A porous system lies between two media and contains a certain internal atmosphere; the gaseous composition of these three are as follows:—

	The air.	The plant gas.	The water gas.
Carbonic acid,	0·05	0·00	30·0
Oxygen,	20·80	13·25	22·0
Nitrogen,	79·15	86·75	48·0
	100·	100·	100·

If the mixture designated the plant gas, were confined within an extremely delicate caoutchouc bag and surrounded by either the water gas or atmospheric air, it would soon be disturbed by penetration, nitrogen would be slowly eliminated and carbonic acid and oxygen absorbed. The rapidity of the movement would depend on the gas and also the character of the membrane. So much for the physical consequences; we now proceed to examine what really takes place in the case of plants.

27. The action of the roots on the water gas existing in the soil, and represented by that in pump-water, is given at length in the last division of the memoir; as there are no experiments on the subject accessible to me I must advance my own in confirmation of the correctness of the physical theory. In M. Boussingault's Economie Rurale, it is stated that M. Piobert found that roots absorbed nitrogen, but as I have not seen any evidence of this I cannot admit it in opposition to my experiments.

28. But that there might be no doubt on the action of a porous vegetable tissue, such as envelops every part of plants, when containing an atmosphere similar to that called the plant gas, and surrounded by a mixture resembling the water gas, the experiments detailed in section 7 were contrived. The results in these cases were directly coincident with theory. If it be admitted that the epidermis employed resembles the tissue of the roots, the consequences must also be admitted. That the tissues are analogous and would act in the same way may be inferred from the observations of M. Payen, who maintains that the enveloping cellular tissue of all parts of plants (*cellulose*) has a definite composition; and if the chemical nature be the same, the affinity for different gases and fluids will be identical. There is but one other disturbing cause, which we cannot enter upon in this place, —the affinity of the gases and fluids stored within cellules and closed vessels. Now the bounding membrane of a cell may exert an attractive force towards a given gas or fluid, which, notwithstanding, never penetrates to the interior because of the antagonism of the included substance, which does not combine with it, and therefore the passage is arrested at the internal limit of the membrane. Whatever effect may arise from this or any other cause in the complex processes of the higher vegetation are not before us now; the absorption and evolution of certain gases by plants is the resultant of all the internal actions, and with these only are we concerned.

29. If we consider the action of leaves on atmospheric air, the theory of physical penetration is more certainly established. In this case we find oxygen and carbonic acid absorbed and nitrogen liberated in the same way as in the experiments in section 7, where the plant gas, nitrogen 87·0, oxygen 13·0 per cent., was brought in contact by a piece of epidermis with a mixture of common air and ten per cent. carbonic acid. With living plants the experiment has been made by the most skillful observers, as Saussure, Davy, Daubeny, and others. In Saussure's researches nitrogen was always evolved, whilst carbonic acid and oxygen were absorbed. It is not indeed admitted by all vegetable physiologists that oxygen is uniformly absorbed and nitrogen thrown out during the growth of the green parts, but upon examining the best experiments these facts will be found abundantly confirmed. Saussure always observed the evolution of nitrogen, whether the plants were immersed in air or water. De Candolle,

Palmer, Daubeny, and Draper, also sustain this position. The uniform absorption of a portion of oxygen by the plant, is proved by the researches of Gough, Achard, Scheele, Cruickshank, Saussure and others. Gough showed that an atmosphere without oxygen was incapable of producing the green color of leaves by changing the yellow color of such as were raised in darkness, (*Manch. Mem.*, iv, p. 501.) This singular fact is now explained by the discovery of the nature of chlorophyl, which M. Preisser shows to be an oxydized product.

30. The absorptions taking place under the influence of light owe their continuance during the growth of the plant to its action. The gas entering, is destined to equilibrate the internal atmosphere and give it a composition analogous to common air, but this it is incapable of accomplishing because of the decomposing action of light. Hence a constant current of carbonic acid sets into the plant, the oxygen of which is partly employed in producing chemical results, and a deficiency of both carbonic acid and oxygen is consequently presented by the plant atmosphere, these two bodies being withdrawn by the organic changes faster than they penetrate.

31. It is only so long as the carbonic acid and oxygen are appropriated by chemical forces that the internal plant gas differs materially from common air. As soon as decomposition by the sun's light is arrested, the absorption of carbonic acid from the atmosphere ceases, and that portion which rises along the roots, is, according to Ingenhousz, in part thrown into the air. Oxygen is still absorbed for the production of special compounds. After a time, supposing the chemical affinities satisfied, the plant atmosphere has obtained an equilibrium with the air, and all movements cease. In Messrs. Calvert and Ferrand's experiments, the increase of carbonic acid during night in the plant gas is a constant feature, the oxygen also became equal to the proportion in air. Under these circumstances if the fluid absorbed from the earth be rich in carbonic acid, a portion will be evolved as soon as it has been conveyed by the sap into the plant atmosphere in excess. This condition may not be satisfied in one case, and no carbonic acid liberated, as found by Mr. Pepys, whilst in another, from the nature of the soil, the gas may be abundantly thrown out, as proved by Saussure, Ingenhousz, and others.

32. We are therefore justified in regarding a plant as a porous system, the normal or internal atmosphere of which has a com-

position resulting from the continued absorption of oxygen and carbonic acid during daylight. The deficiency thus caused as the first effect of the sun's rays, brings into operation the laws of diffusion. From the common atmosphere, carbonic acid and oxygen enter through the epidermis of the leaves, whilst the spongioles give passage only to such a gaseous mixture as is required by the sap. The gases thus finding entrance to equilibrate a deficiency, are in their turn decomposed or appropriated, at first by a decomposition of carbonic acid an excess of oxygen is produced, but a portion being evolved, the per-centage within is gradually diminished until it becomes less than that of the atmosphere. The same changes continuing during daylight, a stream of carbonic acid sets into the plant, whilst portions of its oxygen with nitrogen are liberated; oxygen with carbon being continually fixed by the plant. It is the unsatisfied equilibrium of the internal gases which originates and maintains the current.

V. *The effects of Artificial Atmospheres upon Plants.*

33. But to show more distinctly the mere physical porosity of vegetable tissues, we may examine the interesting observations of M. Marcet, which like many other similar facts remain unassimilated. This observer found (*Ann. de Chim., &c.*, t. lviii, p. 407) that the same species of fungi exposed to different atmospheres, as common air, pure oxygen, or pure nitrogen, gave off dissimilar gases. If we investigate these results, it will be seen that in each case the theoretical indications of a porous system are satisfied. The table gives a synopsis of the action of the same living fungi on the three atmospheres; in each case 100 volumes of the gas were used, and after the plants had been immersed therein eight to ten hours its composition was ascertained and found—

	Atmospheres.		
	Common air.	Oxygen.	Nitrogen.
Oxygen, . .	2·0	31·3	0·0
Nitrogen, . .	77·0	24·0	96·1
Carbonic acid, .	21·0	44·7	3·9
	100·	100·	100·

From the composition of the resulting gas, it is apparent that the plant atmosphere of these fungi contained a high per-centage of nitrogen and carbonic acid with a deficiency of oxygen, adopting this speculation the effect upon the three atmospheres

coincides precisely with the result. There cannot be a more complete proof of the absence of any specific antagonism or vital force than is presented in these and similar experiments; the gases expired are distinctly the same as should flow out by exosmosis.

34. The property of evolving nitrogen in the families of fungoid Cryptogamia, associates them to the Vasculares, and shows that whatever points of difference may exist between these divisions of the vegetable kingdom in other respects, there is in this respect an uniformity of action of the greatest interest, as the chemical changes leading to the separation of nitrogen, belong to all living plants. The large absorption of oxygen in fungi is a prominent function, they do not appropriate it in the same limited way as other plants, but are even capable of decomposing water for its attainment, the hydrogen being liberated. This phenomenon has been witnessed by Humboldt, De Candolle, and M. Marcet.

35. In the researches of Th. de Saussure on germination, an interesting case of physical penetration occurs, which has produced some confusion among theorists. In the Memoires de la Societé Physique, &c., de Genève, t. vi, p. 545, it is stated that seeds germinating in common air absorb nitrogen gas; but that when the process is conducted in an atmosphere of equal volumes of nitrogen and oxygen, none is absorbed. This is precisely the result to be expected, on the hypothesis that the absorption of gases is a physical phenomenon: so long as the atmosphere without contains 80 per cent. nitrogen, this gas is absorbed to produce a compensation in the plant gas, but when it is reduced to 50 per cent. absorption ceases, the seeds and growing parts, containing a sufficiency in their pores.

36. How far confusion may arise in questions of vegetable physiology, if we overlook the physical laws of penetration, is made evident by the contradictory statements of Saussure, Ingenhousz, Plenk and De Candolle, on the absorption and evolution of gases by the green parts of plants placed in artificial atmospheres. Les parties verts laissent moins de gas oxigène dans le gas hydrogène que dans le gas azote; elles ne paraissent, contre l'assertion d'Ingenhousz, absorber ni l'un ni l'autre. Il parait aussi certain, malgré l'assertion d'Plenk, qu'elles n'exhalent point de gas azote, sauf dans quelques cas, par les corolles.—*De Candolle Physiologie Veg.*, t. i, p. 133.

37. Some observations made by me in the summer of 1844, also serve to verify the position, that the gases exhaled by plants are not constant, but depend upon the atmosphere in which they are plunged. Specimens of the *Conferva mucosa* were placed in pump-water, which is their natural medium, and others in distilled water impregnated with carbonic acid gas, and exposed to sunlight. In six hours the gases produced in the receivers were entirely separated, and the arrangement left for twenty-four hours without any fresh water; the gases were again withdrawn, and thus for four and five days, no fresh water being added throughout. It is evident that the gas of the water was constantly changing in its composition, and therefore the experiments were the same as if made in a number of different artificial mixtures of gases.

The plants in pump-water gave in the first six hours an expired gas, consisting of oxygen 73, nitrogen 27 per cent.; in twenty-four hours, oxygen 53, nitrogen 47 per cent.; in forty-eight hours, oxygen 18·6, nitrogen 81·4 per cent. The specimens in carbonated water produced in six hours, gas consisting of oxygen 68, nitrogen 32 per cent.; in twenty-four hours, oxygen 63, nitrogen 37 per cent.; in forty-eight hours, oxygen 12, nitrogen 88 per cent.; in seventy-two hours, oxygen 3·5, nitrogen 96·5 per cent. These latter were in no way injured at this time, for upon adding a little fresh fluid they yielded at ninety-six hours, a gas consisting of oxygen 15, nitrogen 85 per cent. The aliment of these plants was not changed, for they continued healthy, the different gases expired were merely the result of physical necessity, the aëriform matter of the water being continually changed. I do not assert that all the nitrogen in the foregoing measures was thrown out from the interior of the plants, because as we have already shown in section 24, the physical disturbance of the water gas will be attended with the evolution of nitrogen, and although distilled water was used, there is no process by which all its gas can be driven out.

38. *Conclusion.*—From the preceding evidence I infer that plants are a simple porous system, so far as they are related to the air and the gases of fluids in the soil, leaving out of consideration the internal phenomena of penetration. The advantages resulting from the adoption of this philosophical view of vegetation, both in assimilating facts hitherto insulated and criticising experimental arrangements in vegetable physiology, form its great

recommendation. For illustration, we adduce two general laws which spring from this theory.

1st. No hypotheses nor arguments can be based on the composition of the gases expired by plants, without a rigorous regard to the influence of disturbing causes—as the amount of light, gas of the fluids of the soil, of the atmosphere, &c.

2d. No experiments on the action of plants in sunlight or otherwise, can be adduced for physiological argumentation, unless made in atmospheric air. Many observations have been made on plants immersed in water and artificial atmospheres, which cannot be received, because the gases employed have penetrated the interior in proportions differing from those in the case of common air. The nitrogen obtained by Saussure may in a great measure have been derived from the additions of carbonic acid made by him to the atmospheres in which he experimented; and in the observations made in water, much of the nitrogen is unquestionably derived from the fluid.

39. Finally I would present the following summary of conclusions as fairly deduced from the preceding experiments.

1. The *epidermis* of plants, so far as experiments have been made, is porous and permits the passage of gases, according to the physical laws of penetration.

2. The *roots*, during the existence of chemical changes in plants, absorb such gases only from the soil fluids with which they are in contact, as will indirectly satisfy the indications of the internal atmosphere.

3. The *internal gas of plants*, or plant atmosphere, is continually fluctuating with the forces which operate upon it; during a state of activity in the plant, it resembles a mixture of nitrogen 86·75, oxygen 13·25 per cent., but at night appears to contain more oxygen, and from 2 to 3 per cent. of carbonic acid.

4. Its active or *normal* composition is that indicated by a mixture into which carbonic acid and oxygen are being diffused during day-light.

5. The *porosity* of the entire plant is fully established by its action on artificial atmospheres.

Therefore the physical structure of plants is that of a porous system, subject to all the laws of diffusion, and endowed with no vitality other than that resulting in the formation and development of Cytoblasts and their arrangement after a definite type.

New York, March, 1846.

Art. VII.—*On Zoophytes;* by J. D. Dana.*

The singular features of the growing coral field, the resemblance to vegetation in its productions, as well as their beauty and variety, have long excited the attention even of those little curious in the forms of living nature. Trees, shrubs, and other plants of various kinds are represented with wonderful exactness, as if they had been the types of this branch of the animal kingdom; and they grow mingled together often in rich profusion like the plants of the land. The similarity, moreover, is not confined to general form: corals have their blossoms; for polyps are flowers both in figure and beauty of coloring. Like the pink or Aster, they have a star-like disk above; and while some are minute, others are half an inch or even two inches in diameter. Every part of a Madrepore when alive is covered with these blossoms: a Gorgonia, though merely a cluster of naked stems, as seen in our cabinets, consists, when in the water, of as many crowded spikelets of flowers.—Thus it is with all zoophytes. Nothing could be more untrue than the night-mare dreams of a favorite poet.†

> "Shapeless they seem'd, but endless shapes assumed;
> Elongated like worms, they writhed and shrunk
> Their tortuous bodies to grotesque dimensions.—"

And again, they are described as issuing from the coral, like

> "capillary swarms
> Of reptiles horrent as Medusa's snakes."

Polyps are not writhing worms. The choicest garden does not produce flowers of more graceful figure or gayer colors, than those of the zoophyte reef; and we may add too, that the birds of the groves will not rival the rich tints of the fishes that sport

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* In the series of articles on zoophytes, which it is proposed to prepare for this Journal, the writer presents the facts and principles that have been published in his Report on Zoophytes, one of the volumes of the late Exploring Expedition under Capt. Charles Wilkes, (see this Journal, Second Series, vol. i, p. 178.) The subject is however condensed, and the stile and arrangement altered to adapt it to these pages, and give it a somewhat more popular character. It is the writer's endeavor to present a succinct account of this department, about which there is little generally known, without confining himself to original observations.

† Montgomery's Pelican Island.

among the coral branches. The coral tree is without verdure, but there is full compensation in its perpetual bloom.

It is not surprising that these resemblances should have misled early investigators. For a long period only the external forms of zoophytes were known, and every analogy observed authorized their arrangement with plants.* The discovery of the flowers or seed of corals was yet to be made to prove the identity; and at last, Marsigli, an active explorer of the Mediterranean, came forward with this veritable discovery itself, and published figures of "*les fleurs du corail*"—the coral blossoms.† Other discoveries followed: but it was soon shown, that these flowers, were gifted with the attributes of *animal* life. This observation is said to have been first made by Ferrante Imperato, a naturalist of Naples, who published his *Historia Naturale* in 1599.‡ It was however demonstrated independently, as is believed, and more thoroughly, by Peyssonel, who wrote an elaborate memoir on certain species examined by him in the West Indies.§ But before a transfer of zoophytes from the vegetable to the animal kingdom was generally allowed, the subject was one of warm debate among the philosophers of the day. The animals detected were suspected of being parasites, and pronounced as too inefficient for the production of trees of stone with their spreading branches; while the formation of coral was attributed to a kind of vegetable growth by some, and to mineral aggregation or crystallization by

* Among the authors who arranged corals with the vegetable kingdom are Dioscorides, Cæsalpin, Bauhin, Ray, Geoffroy, Tournefort, and Marsigli.

† Marsigli, Physique de la Mer, Amsterdam, 1725. His first observations were made in 1706.

‡ See Blainville's Manuel d'Actinologie, p. 14.

§ Peyssonel's Memoir covers 400 pages of manuscript. It was sent to the Royal Society in 1751, and an abstract of it was read, which appeared in the Transactions for 1753, (vol. x, of the Abridgment.) The Memoir, though for many years supposed to be lost, is still extant in the library of the museum at Paris; and a late notice of it by M. Flourens may be found in the Annales des Sciences Naturelles, 2nd ser., ix, 334, 1838.

Dr. J. Parsons made a labored and apparently successful reply to Peyssonel before the Royal Society in 1752, in which he argues *ab ignorantiâ*: "It would seem to me much more difficult to conceive that so fine an arrangement of parts, such masses as these bodies consist of, and such regular ramifications in some, and such well contrived organs to serve for vegetation in others, should be the operations of poor, helpless, jelly-like animals, rather than the work of more sure vegetation, which carries on the growth of the tallest and largest trees with the same natural ease and influence as the minutest plant."

others.* The scientific world was divided, and Reaumur in his earlier writings condemned the new views advocated by Peyssonel as too absurd to be discussed. The investigations of Trembley on the Hydra polyps, and of Jussieu of other species obtained on the sea-coast of France, finally convinced Reaumur. Ellis by a laborious series of investigations, led the way in England; and though his facts were doubted by some, they were soon received with full credit.† The figures of these authors represented actual flowers, as regards form; but these flowers were shown to have a mouth, and to be capable of eating like animals. They were actually fed, and the process of digestion watched through its different stages. Moreover they were shown to be an essential and constituent part of the zoophyte. The petal-like organs which produce the striking similarity to flowers, were observed in some instances to be used as arms in taking their prey and conveying it to the mouth; for which purpose they were conveniently arranged in a circle around the mouth. The coral blossoms were consequently declared to be animal in every essential character. Yet Linnæus, after long hesitation, advanced no farther than to admit for zoophytes an intermediate nature between plants and animals. Thus more than a century elapsed after the discussion commenced, before this one simple fact in science became generally believed, that zoophytes are animals, and resemble plants only in sometimes assuming the shapes of vegetation. The point is now no longer doubted.

In these remarks we exclude sponges from the class of zoophytes. Their nature is still a subject of dispute, and some of the most distinguished names in science are committed on opposite sides. If animals, they have only the most general properties of animal life, and are less nearly related to polyps than to the infusorial animalcules. They are arranged with the latter by Dujardin.

Though zoophytes have no connection with the vegetable kingdom, polyps may be styled with much propriety *flower-*

* P. Boccone, *Museo di Fisica*, &c., Venice, 1694, 1 vol. 4to, with figures. Baker, *Employment for the Microscope*, pp. 218—220. London, 1753.

† Ellis published various memoirs in the Philosophical Transactions, from the years 1753 to 1776, and also a work entitled *Essay towards a Natural History of Corallines*, 4to, with plates; London, 1754. A posthumous work of this author was afterwards published by Solander, under the title, *The Natural History of many curious and uncommon Zoophytes*, 4to, with 63 plates, London, 1756.

animals. The word zoophyte,* originally used by Linnæus, alluded to their supposed intermediate nature. Still, the name is sufficiently appropriate, although the idea in which it originated is exploded. They are plants in form even to the coral-polyps which blossom over the surface. Yet in the mode of receiving, digesting, and assimilating nutriment, and every other function of life, they are animal.

The relation of the coral to the coral animal, and the mode of its formation, are subjects about which much error has been published; and although now correctly explained in some scientific treatises, very erroneous impressions largely prevail. Without entering into particulars in this place, one single fact should be here stated and duly considered. It is this:—coral is not the residence or hive of polyps. On the contrary, it is contained *within* the polyps, instead of containing them. It is formed *within* them by animal secretion, as bones are formed within other animals; and in most living zoophytes it is wholly enclosed, showing not a spine or point externally. This is the case with the Madrepore; no part of the coral is seen externally while the animal is alive in the water. The idea that coral polyps retreat into cells, is therefore wholly without foundation. Sometimes the summit or flower-shaped part of the polyp becomes concealed, in a manner a little similar to the withdrawal of a turtle's head; but even this semblance of retreat is by no means general among the ordinary coral zoophytes.

There is no mechanical accumulation of material by the polyp. They are as unconscious of the coral secretions going on within them, and as free from actual labor and industry, as we are in the construction of our bones.

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* The word zoophyte is from the Greek ζωον, *animal*, and φυω, *to grow like a plant.* Blainville states that the term was introduced by Sextus Empiricus and Isodore de Seville in the sixth century. It has been differently restricted in its use by authors, and on account of its various applications, is wholly rejected by Lamarck. Other late scientific writers retain it, and it is also the popular designation.

Ehrenberg has proposed to substitute *Phytozoa*, derived from the same roots. But science requires a name that will apply to the whole compound structure—the coral tree, sea-fan, or mass of whatever shape;—and phytozoum refers only to a *single* polyp, or phytozoa to polyps in general. These cannot supply the place of the very convenient terms zoophyte and zoophytes. Moreover the term phytozoa or phytozoaires (plant-animals) has been applied to the minute monad-like cellules found in the tissues of some plants, and supposed to be animalcules or plant-entozoa.

The existence of such terms in the science as *polypary*, *polypidom*, applied to coral, signifying a *hive* or *house of polyps*, indicates the errors of former days; errors which science should not perpetuate. As a substitute, the old term *Corallum** is convenient and unobjectionable. *Corallium* has been rejected because of its application to a particular genus of corals. In *Corallum*, we have a familiar word; and one which implies no hypothesis or erroneous comparison. The analogy between the work of the polyp, and that of the bee or ant, though often suggested, is wholly without foundation.

The existence of coral secretions, is by no means essential to the existence of polyps. Although a large number of species form coral, there are also many that are wholly fleshy, or secrete only a few scattered granules of lime. The Actiniæ, or sea-anemones, as they are familiarly called, are examples of these fleshy species. In every point of structure, and in every function except that of coral-secreting, they are identical with coral animals. They have also the same resemblance to flowers when expanded, and their rich tints and large size make them the most brilliant flower-animals of any seas.

One of the most singular characters of zoophytes, is their frequent compound nature. The branching Madrepore is an example of this *compound* structure. There are hundreds of polyps united in a single individual. Each little prominence containing a cell pertained to a separate animal; and by counting these prominences over a branch of coral, the number of flower-animals combined in its production may be ascertained. In the same manner, in Astræas, each radiate cell or depression over the surface marks the site of a polyp. The many animals, though distinct in some functions are still mutually dependent in others, as we shall explain in the sequel.

Although these compound forms are most common, yet there are other zoophytes which are always *simple* polyps. The coral

* Coral has been variously designated in both ancient and modern times. The terms Corallium, Corallum and Curalium, were all used by the ancients, and their derivations and use are discussed at length by Theophrastus in his work on plants, Book IV. Κουραλιον is the ancient Greek form, as says Dionysius, "παντη γαρ λιθος εστιν ερυθρου κουραλιοιο." The more recent Greeks, among whom are Dioscorides and Hesychius, wrote the word κορραλλιον. Among the Latins, Ovid wrote, "Sic et *curalium* quo primum contigit auras tempore durescit." Avienus uses Corallum: "Fulvo tamen invenire *Corallo* quærere vivendi commercica." Among the derivations suggested, that of κορη, *damsel*, and 'αλς, *sea*, appears the most probable.

in such cases is a single isolated cup or radiated disk, and the coral animal is a solitary flower. These simple polyp-flowers instead of being microscopic, are often of large size. While many are but one or two lines in diameter, others are one or two feet. The large Fungia with its stellate surface and sprinkling of emerald tentacles around its central mouth, is one of the most beautiful objects of the coral reef.

The foregoing remarks are presented as an introduction to a more particular account of the structure and habits of zoophytes.

Art. VIII.—*Reply to the criticism on Prof. Twining's Demonstration relating to Parallels.**

To the objections to my proof of Euclid's *postulatum* offered by the Editors of the Journal of Science, upon authority which is shown by the appended initials to be highly worthy of credence, I should have sooner replied but for excess of occupation. Even now I feel constrained to such brevity as may involve the hazard of a want of clearness, except for such readers as may care to refer back to the original PROPOSITION.†

The objector first observes "there must be *some* fallacy" in the reasoning, as cases might be pointed out "where false conclusions would result from applying it with proper modifications, though without essential change." In reply it is sufficient to remark, that, as the principle on which the proof depends, is competent, in my own view, to sustain the most rigid scrutiny, I could not but be incredulous as to the possibility of any such case—*even were it shown that my particular application of the principle to the proof in question involves a fallacy.* It is the less necessary to protract discussion, at this point, inasmuch as the objector has preferred the method—the more masterly one if it can prevail—of specifying the particular respects or steps in which the reasoning fails.

He intimates the existence of several—all however "similar" to the one which alone he specifies as the type of all. A particular conclusion on page 95 is pointed out as "inadmissible," on the ground that "it is founded plainly on the assumption, that

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* See this Journal, vol. i, Second Series, p. 147. † Ib. pp. 94—96.

in determining the angle BAD to be such as to contain all of a certain class of lines, every other line is excluded from it; in other words, that the line AD, which is the limit of a certain class of lines, must itself be comprehended in that class." Now, as to the assertion in the first member of this sentence, the reader will perceive by referring to p. 95, that what the critic has treated as an *assumption*, is, in fact, explicitly a *condition of the hypothesis*. For not only the application itself, in the argument, evinces what was meant by the concise definition of the angle BAD, as being "constituted by the condition that it can contain all the lines drawn, &c.," but the terms themselves intend that "every other line is excluded," as completely as if that phrase had been adopted in the wording;—how else could the angle be said to be *constituted*, or what is the same, *defined*.* If then the line AD is one of the class of which the angle BAD is defined just to contain all and "*no other*," (if that last part of the expression is important to appear in the wording,) it is contained by the angle, in accordance with the *hypothesis*, and on the reverse supposition it is, *by the hypothesis*, excluded.

I perceive, therefore, in the step objected to, no defect even of expression. The discerning reader cannot fail, at least, to take the argument, in its real force and meaning, to be as follows:—If you constitute BAD capable of containing all those lines and those only through A, which, if produced, would meet FG on the side towards G, you cannot constitute DAC similarly conditioned with respect to all those which would *not* meet. The ground of this assertion *lies in the antecedent proof* that under such a supposition, AD must be contained by both BAD and DAC or by neither, and, under the hypothesis, either side of the dilemma involves the absurdity that AD meets and does not meet at the same time. I know not what attempt can be made to escape from the conclusiveness of this reasoning, unless by either denying *the allowable character of the hypothesis itself*, or taking the ground that when a line divides an angle, *the being contained in either part or not contained, cannot be predicated of the line.* The first, or a denial of the hypothesis, is forbidden by the perfection of the idea of *space:* the latter ground, if taken, would

* Thus, to refer, *for exemplification merely*, to an instance in common parlance—if the gallon measure were said to be *constituted* so as to contain 231 cubic inches, the obvious intent would be *just that amount and no more.*

not weaken the argument; for since the angle BAD is expressly conditioned to contain all the lines of a certain class, and only such lines, it follows that if it cannot be predicated of AD that it is contained in the angle it is not one of the class, and *vice versa*.

Turning now to the other part of the objection, in the second member of the sentence above quoted, beginning with the phrase "in other words," I maintain it to embody not other *words* merely, but other *ideas*. Not only the two clauses convey propositions that are not identical, but the latter is not deducible from the former, neither does it seem relevant to an argument which turns not upon ideas of "limits" or limiting lines, under a classification simply *logical*, but upon a certain *natural* or *geometrical* relation of a line dividing an angular space to the component parts of the space it divides.

If, therefore, no more weighty objection than these or the "similar" ones adverted to can be adduced by a critic of such unquestionable discernment as the one whose authorship I perceive in his initials, it may be counted as a new *symptom*, added to those remarked upon in the original paper, of the genuineness of the reasoning; and with respect to the epithet "plausible," applied by the Editors of this Journal—in a manner entirely courteous I acknowledge—to that reasoning, I should not hesitate to transfer it, in a manner not *uncourteous* I trust, to the objections urged against it.

If there is a fallacy in the attempted demonstration, it is to be found, as I judge, after carefully revising the method, in the following conclusion near the bottom of p. 95, "and, of course, HAD must contain all that can meet on neither side." If an objector should urge that, although under the supposition of more lines than one that meet on neither side, HAD might be constituted, independently, to contain them *all* and no others, yet that such a constitution could not co-exist or be compatible with the antecedent constitution or definition of BAD and DAC, I acknowledge that the best answer I could give, at present, does not seem entirely satisfactory.

May 5th, 1846.

ART. IX.—*Abstract of Thermometrical Records kept at the Missionary Stations of the American Board of Commissioners for Foreign Missions in Western Asia;* collected and collated by REV. AZARIAH SMITH, M. D.

THE accompanying abstract of a number of thermometrical records, has been arranged in a tabular form, to present to the reader the relative temperature of the different missionary stations of the American Board in Western Asia. The records from which this abstract was prepared, were kept, for the most part, by persons accustomed to such observations, and may be depended upon for accuracy. The posts of observation have indeed been cities, and where there has been more or less difficulty in securing a place for the thermometer free from the direct or reflected rays of the sun, but it is believed that care has effected all that could be done to avoid error from these circumstances. With the exception of three or four months in the Oormia register, the records exhibit the omission of observations for scarcely a single day other than those noted in the table, and even in the Oormia record, the omissions are not such, it is hoped, as materially to detract from its value as affording a general indication of the temperature of that place. Several of the records from which this abstract was made, contain full statements of the aspect of the sky, morning, noon, and night; several also note the direction of the wind at these times; and a few have complete and well kept barometrical observations. As the barometrical registers however have been already published, and as it is impossible to collate the observations on the sky and the currents of the air into a compact form, I have reluctantly substituted for these a few brief general remarks, and in the abstract, confined myself, to the thermometrical records.

As it may add to the value of the observations for 1844, I would mention in conclusion, that the registers for that year were kept according to previous arrangement, *simultaneously*, and with the express design to furnish a comparative view of the temperature of the places in which the records were made. It is to be hoped that the publication of this abstract may call out similar ones from American missionaries stationed in other parts of the world.

Place of record.	Year of the record	Average temp. sunrise.	Average temp. 2 P. M.	Average temp. 9 P. M.	General av. for month.	Coldest temp. and its date.		Warmest temp. and its date.	
JANUARY.									
Oormia, ...	1845	11°	22°	14°	15·67		3°		36°
Erzeroom, ...	1836	*16·27	†16 37				−10		38
	1837	*16·8	†22·39				−4		40
	1838	‡17·81	19·51	‖8·54	15·29		−20		34
Trebizond, ...	1839	*41·16	†47·39				39		64
	1844	44·52	48·35	45·68	46·18	28th,	31	12th,	62
	1845	*39·64				12th,	31	28th,	53
Constantinople, (Bebek,)	1844	38·70	42·13	39·40	40·07	20th,	24	29th,	53½
	1845	40·1	47·73	42·19	43·34	20th,	30	23d,	58
Constantinople, (Pera,)	1840	§37·35	41·35	**39·35	39·68		18		54
	1841	§42·71	45·48	**43·35	43·85		29		56
Broosa, ...	1844	35·	41·5	38·	38·17	27th,	24	9th,	58
	1845	36·32	46·81	39·1	40·74	16th,	25	31st,	60
Smyrna, ...	1844	39·	49·	42·66	43·55	27th,	27	23d,	57
Beirût, ...	1843	54·	59·25	††57·36	56·88		51		67
	1844	50·	59·14	52 04	53·76	23d,	44	18th,	71
	1845	46·74	57·90	49·19	51·28		36		64
Aitath, ...	1843	46·	53·30	††50·	49·75		42		59
Jerusalem, ...	1844	44 63	51·09	47·45	47·72		40		61
Mosul, ...	1844	38·	47·	††46·	43·67	1st,	30	14th,	55
FEBRUARY.									
Oormia, ...	1845	25·	40·	28·	31·		8		56
Erzeroom, ...	1836	*25·93	†27·67				10		41
	1837	*19·08	†21·81				0		38
	1838	‡23·37	25 06	‖14·18	20 87		−10½		42½
Trebizond, ...	1839	*46·56	†46·92						
	1844	50·1	52·85	51·96	51·04	20th,	38	23d,	67
	1845	*46·46					33	4th,	66
Constantinople, (Bebek,)	1844	47 0	48·9	49·3	48·4	2d,	36	29th,	69
	1845	40·14	45·33	40·57	42·01		18	3d,	62
Constantinople, (Pera,)	1840	§37·59	41·04	**38·07	38·90		25		59
	1841	§37·25	42·82	**38·57	39·58		31		56
Broosa, ...	1844	47·5	55·5	50·0	51·0	26th,	36	29th,	72
	1845	40·38	47·36	41·18	42·97	22d,	23·5	2d,	65
Smyrna, ...	1844	47·02	59·48	50·39	52 3	18th,	32	29th,	68
Beirût, ...	1843	56·71	63·35	††61·89	60·82		53		69
	1844	52·80	62·33	55·25	56·79		48		70
	1845	52·82	64·03	54·10	56·98		47		72
Jerusalem, ...	1844	50·02	58·09	53·07	53·73		45		66
Mosul, ...	1844	44·	††55·	51·	50·	1st,	35	26th,	63
MARCH.									
Oormia, ...	1845	26·	37·	30·	31·	11th,	22	24th,	70
Erzeroom, ...	1836	*30·75	†35·87				1		49·5
	1837	*37·41	†34·11				14		52
	1838	‡34·06	35·87	‖24·05	31·33		15		48
Trebizond, ...	1839	*43 41	†43·45				39		51
	1844	50·26	52·84	50·52	51·21	17th,	40	10th,	71
Constantinople, (Bebek,)	1844	46·29	51·16	44·9	47·45	31st,	38	8th,	67
	1845	47·13	55·26	49 19	50·53	3d,	34	19th,	78
do. (Pera,)	1840	§37·84	42·52	‖39·06	39·81		24		57
	1841	§39·19	43·29	‖40 06	40·84		29		53
Broosa, ...	1844	45·	53·	47·5	48·5	25th,	36	9th,	76
	1845	50·13	59·65	52 55	54·11	25th,	35	20th,	86
Smyrna, ...	1844	47·93	60·93	50·21	53·02	15th,	39	9th,	75
Beirût, ...	1843	57·16	65·32	††58 88	60·32		50		73
	1845	57·87	69·	59·70	62·19		49		84
Aitath, ...	1843	50·23	58·14	††52·50	53·62		40		76
Jerusalem, ...	1844	53·	69·	58·03	60·01		47		74
Mosul, ...	1844	51·	62·	††58·	57·	17th,	45	21st,	69

Index to signs: * 9 A. M. † 4 P. M. ‡ 8 A. M. ‖ 8 P. M. § 7 A. M. ** 10 P. M. †† Sunset.

Place of record.	Year of the record.	Average temp. sunrise.	Average temp. 2 P. M.	Average temp. 9 P. M.	General av. for month.	Coldest temp. and its date.		Warmest temp. and its date.	
April.		☉	☉	☉	☉		☉		☉
Erzeroom, . . .	1836	*46·5	†50 15				34		62
	1837	*46·83	†51 13				41		62
	1838	‡47·23	48·02	‖36 63	43·96		30		64·5
Trebizond, . . .	1838	*51·13	†51·76				39		73
	1839	*47·73	†47·9				44		54
	1844	45 79	48·68	46·66	47·04	13th,	33	29th,	66
Constantinople, (Bebek,)	1844	45·7	52·29	45·27	47·75	13th,	36	27th,	74
	1845	52 63	64·43	55·53	57·53	3d,	34	20th,	80
do. (Pera,)	1840	§43·03	50·37	**44·07	45·82		35		61
	1841	§48·23	55·3	**49·97	51·17		40		64
Broosa, ...	1844	44·	53·	48·	48·33	12th,	34	28th,	76
	1845	53·04	60·03	58·33	60·25	3d,	34	12th,	85
Smyrna, ...	1844	44 43	62·33	52·10	52 95	4th,	35	28th,	80
Beirût, ...	1842				67 80		63		92
	1843	61·13	67·23	††64·13	64·16		55		74
	1845	59·07	71·15	62·	64·07		46		85·5
Aitath, ...	1843	52·97	63·17	††57 27	57 80		42		76
Jerusalem, . . .	1844	49·04	64·	51·07	54·70		38		72
Mosul, ...	1844	50·	62·	††57·	56 33	14th,	38	30th,	75
May.									
Erzeroom, . . .	1836	*52·22	†55·31				34		72
	1837	*40·	†60·				36		66
	1838	‡54 30	58·57	‖46 5	53·12		41·5		67·5
Trebizond, . . .	1838	*63·23	†63·55				58		70
	1839	*60·12	†60·46				51		70
	1844	57 42	61·61	58·48	59·17	1st,	50	20th,	70
Constantinople, (Bebek,)	1844	55·3	62·22	55·18	57·53	3d,	49	17th,	81
	1845	60·26	72·84	64·35	65·82	6th,	49	31st,	87
do. (Pera,)	1840	§58·03	67·48	**60·32	61·94		47		81
	1841	§56·13	65 36	**58·	59·83		48		75
Broosa, ...	1844	57·	67·	60·5	61·5	5th,	50	22d,	77
	1845	62·81	79·35	68·23	70·13	1st,	51	31st,	93
Smyrna, ...	1844	58·35	74·13	64·23	65·57	4th,	48	21st,	84
Beirût, ...	1842				73 83		62		92
	1843	66·13	72 68	††69·10	69 30		56		83
	1845	68 26	76·39	67·64	70·76		57		97
Aitath, ...	1843	59·45	71·13	††64·10	64·89		48		82
Jerusalem, . . .	1843	§61·21	73·14	69 32	67·89		49		90
	1844	64·	69·	64·06	65 69		55		83
Mosul, ...	1844	66·	82·	74·	74·	1st,	58	24th,	91
June.									
Erzeroom, . . .	1836	*65·83	†65·96				43		80
	1837	*65·66					58		71
	1845	51·	67·9	59·2	59 37		36		79
Trebizond, . . .	1838	*71·73	†70 2				66		80
(16th to 30th,)	1843	69·	76·	70·			62		79
	1844	64·77	70·37	67·	67·38	10th,	57	29th,	78
Constantinople, (Bebek,)	1844	62 23	78·43	64·43	70·32	7th,	56	29th,	94
	1845	65·07	77 6	67·2	69·96		56		86
do. (Pera,)	1840	§62 7	71·03	*64·73	66·15		52		76
	1841	§67·27	74·57	*69·03	70·29		59		80
Broosa, ...	1844	64·	80.	70·5	68 17	7th,	54	29th,	96
Smyrna, ...	1844	65·9	82·33	72·14	73·46	22d,	60	30th,	92
Beirût, ...	1842				75·43		69		84
	1843	72·77	77·97	75·43	75 39		69		82
Aitath, ...	1843	64 60	75·27	69·23	69 70		59		84
Jerusalem, . . .	1843	§65·30	77·56	72·16	71·74		60		88
Mosul, ...	1843	80 1	92·31	††90·14	87·52		76		100
	1844	76·	96·	88·	86 67	3d,	65	19th,	104

Index to signs: * 9 A. M. † 4 P. M. ‡ 8 A. M. ‖ 8 P. M. § 7 A. M. ** 10 P. M. †† Sunset.

Place of record.	Year of the record.	Average temp. sunrise.	Average temp. 2 P. M.	Average temp. 9 P. M.	General av. for month.	Coldest temp. and its date.	Warmest temp. and its date.
		°	°	°	°	°	°
JULY.							
Oormia, 15th to 31st,	1844	66·59	86·15	74·	75·58	15th, 64	25th, 88
Erzeroom, . . .	1836	*69·56	†75·11			56	88
	1837	*69·04				56	77
	1845	58·5	76·5	66·5	67·17	46	80
Trebizond, . . .	1838	*74·77	†75·03			70	84
	1843	70·	78·	72·	73·33	60	87
	1844	72·8	79·57	75·7	76·02	9th, 68	21st, 86
Constan. (Bebek) 19 to 31,	1844	71·92	82·04	75·15	76·37	25th, 60	20th, 86
Constantinople, (Pera,)	1840	§73·03	81·23	*74·1	76·12	66	88
Broosa, ...	1844	71·5	87·5	78·5	79·17	24th, 63	4th, 98
Beirût, ...	1842				82·38	76	95
	1843	78·15	84·74	81·67	81·52	74	88
Aitath, ...	1843	71·16	78·71	75·26	75·04	64	87
Bhamdun, 20th to 31st,	1843				73·50	68	78
Jerusalem, . . .	1843	§72·35	84·44	75·23	77·34	66	94
Mosul, ...	1843	82·1	100·97	††94 48	92·52	74	106
	1844	86·	10·6	95·	95·67	10th, 78	24th, 114
AUGUST.							
Oormia, . . .	1844	68·	83·	73·	74·67	10th, 57	1st, 89
Erzeroom, . . .	*1836	*69·12	†80·5			62	86
	1837	*65 37				56	75
	1845	59·5	79·5	67·5	68·83	52	84
Trebizond, . . .	1838	*75·19	†75·32			70	81
	1843	71·	80·	68·	73·	45	85
	1844	70·93	77·91	74·4	77·47	26th, 67	1st, 84
Constan. (Bebek,) 1 to 8,	1844	70·71	83·	75·14	76·28	68	1st, 85
Constantinople, (Pera,)	1840	§69·35	77·87	*71·52	72·91	65	84
Broosa, ...	1844	67·	84·0	74·5	75·17	19th, 61	1st, 92
Beirût, ...	1842				83·00	78	89
	1843	77·07	84·61	81·76	81·13	75	87
Aitath, ...	1843	64·11	77·05	72.63	71·26	66	82
Abeih, ...	1843	65·03	72·94	67·26	68·41	59	80
El Abadiyeh, . .	1843	65·64	75·54	72·68	72·29	62	81
Bhamdun, . . .	1843				69·16	62	84
Jerusalem, . . .	1843	§68·25	79·06	70·33	72·55	66	90
Mosul, ...	1843	81·03	98·	††92·9	90·64	74	105
SEPTEMBER.							
Oormia, ...	1844	57·	78·	64·	46·33	24th, 50	5th, 85
Erzeroom, . . .	1836	*55·37	†64·19			38	76
	1837	*60·65				44	69
Trebizond, . . .	1838	*73·17	†72·93			68	78
	1843	65·	73·	66·	68·	59	79
	1844	68·13	73·83	69·56	70·51	23d, 63	2d, 81
Constantinople, (Bebek,)	1844	65·28	76·31	68·31	69·93	29th, 60	2d, 83
do. (Pera,)	1840	§65·43	72·87	**67·3	68·53	60	84
Broosa, ...	1844	63·	79.	68·5	70·17	28th, 58	14th, 89
Smyrna, ...	1843	60·2	76·51	68·1	68·27	51	85
Beirût, ...	1842				82·67	78	93
	1843	72·77	82·13	††74·83	76·58	70	86
Aitath, ...	1843	64·87	72·93	††69·10	68·97	59	80
Abeih, ...	1843	59·52	68·69	††64·15	64·12	54	80
El Abadiyeh, . .	1843	62·47	72·13	††68·67	67·76	58	85
Bhamdun, . . .	1843				71·83	62	83
Jerusalem, . . .	1843	70·28	77·18	69·27	72·24	62	89
Mosul, ...	1843	71·71	87·69	††83·55	80·98	30th, 68	18th, 93

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Place of record.	Year of the record.	Average temp. sunrise.	Average temp. 2 P. M.	Average temp. 9 P. M.	General av. for month.	Coldest temp. and its date.	Warmest temp. and its date.
OCTOBER,							
Oormia, ...	1844	48°	65°	55°	56°	21st, 40°	12th, 72°
Erzerôom, ...	1835	*51·69	†57·48			43	65
	1836	*48·19	†58·			35	66·5
	1837	‡45·52	48·87	*40·96	45·12	26	62
Trebizond, ...	1838	*60·95	†62·15			49	81
	1843	63·74	69·86	65·42	66·34	54	86
1st to 18th,	1844	60·56	67·75	63·11	63·81	13th, 53	9th, 76
Constantinople, (Bebek,)	1844	59·53	69·56	60·	63·03	2d, 50	17th, 76
do. (Pera,)	1840	§57·58	63·94	**59·29	60·27	45	77
Broosa, ...	1843	57·31	69·35	59·83	62·15	51	79
	1844	57·5	69·	61·5	62·67	20th, 50	22d, 77
Smyrna, ...	1843	55·32	70·73	62·15	62·73	46	79
Beirût, ...	1842				79·82	72	90
Bhamdun, 1st to 15th,	1843				67·33	53	82
Jerusalem, . . .	1843	§64·08	74.04	67·13	68·42	60	89
Mosul, ...	1843	65·3	78·65	††74·71	72·89	56	87
NOVEMBER,							
Oormia, ...	1844	36·	56·	42·	44·67	21st, 23	7th, 68°
Erzeroom, . . .	1835	*35·43	†41·07			6	50½
	1836	*33·52	†40·78			13	54
	1837	‡35·32	40·17	‖33·13	36·21	24	53
Trebizond, . . .	1838	*58·85	†59·38			45	48
	1843	57·	61·	58·17	58·72	46	69
Constantinople, (Bebek,)	1844	55·21	61·72	56·03	57·65	29th, 39	10th, 76
do. (Pera,)	1840	§52·53	57·3	**54·13	54·65	31	66
Broosa, ...	1844	53·	62·5	57·	57·5	29th, 34	10th, 82
Smyrna, ...	1843	49·90	60·34	53·67	54·64	40	70
Beirût, ...	1842				68·56	58	81
	1843	61·10	67·41	62·21	63·57	52	78
	1844	59·77	71·70	63·47	64·98	47	81
Jerusalem, . . .	1843	56·08	62·08	58·63	58·93	48	78
Mosul, ...	1843	56·43	62·5	59·4	59·44	48	79
DECEMBER.							
Oormia, ...	1844	28·	31·	29·	29·33	28th, 12	8th, 46°
Erzeroom, . . .	1835	*22·07	†24·09			0	44
	1836	*19·	†24·05				
	1837	‡22·97	26·04	‖17·55	22·22	–7	39
Trebizond, . . .	1838	*45·77	†46·67			34	57
	1843	44·65	49·29	45·67	46·54	36	62
	1844	*42·03				31st, 30	21st, 54
Constantinople, (Bebek,)	1844	39·68	44·2	40·19	41·36	5th, 26	15th, 53
do. (Pera,)	1839	§43·41	46·1	**43·97	44·49	18	54
	1840	§37·06	40·48	**38·26	38·6	23	55
Broosa, ...	1844	37·5	44·	39·	40·17	6th, 24	13th, 55
Smyrna, ...	1843	39·03	50·93	41·39	43 78	26	62
Beirût, ...	1842				60·13	52	70
	1843	51·26	58·63	††52·52	53·93	42	66
	1844	52·71	60·87	54·42	56·	46	70
Aitath, ...	1842				51·87	42	66
Jerusalem, . . .	1843	§45·	50·08	47·06	47·38	36	58
Mosul, ...	1843	42·45	49·36	47·	46·27	30	57

Index to signs: * 9 A. M. † 4 P. M. ‡ 8 A. M. ‖ 8 P. M. § 7 A. M. ** 10 P. M. †† Sunset.

Abstract of the foregoing, showing the annual average and range of temperature in the specific years—arranged in the order of the average temperatures.

Place.	Altitude.	N. Lat.	E. Lon.	Year, A. D	Av. for year.	Coldest.	Warmest.	Range.
		° ′	° ′		°	°	°	°
Erzeroom, .	6225	39 57	40 57	1838	43·61	-20	84	104
Oormia, . .	5000 ?	37 30	45 10	'44 & '45	50· ?	3	89	86
Bebek, . .	150	41 7	28 59	1844	58·01	24	86	62
Broosa, . .		40 5	29 10	1844	58·22	24	98	74
Trebizond, .	100	41 1	39 45	'43 & '44	59·51	31	86	55
Smyrna, .	50	38 26	27 7	'43 & '44	61· ?	26	85	59
Jerusalem, .	2500	31 47	35 14	'43 & '44	62·80	36	94	58
Mosul, . .		36 19	43 10	'43 & '44	67·80	30	114	84
Beirût, . .	50	33 50	35 28	1843	68·32	44	90	46

The former of the above tables, it is thought, sufficiently explains itself. The comparison instituted between the temperatures of the several places mentioned in the latter, should be considered only as an approximation to accuracy, since, as will be seen by reference to the first table, some of the records from which it was prepared were incomplete; and those not so, want for perfect uniformity as to the hours of the day, and even as to the year, when the observations were made. Still, with these, and any other imperfections which the strictest scrutiny may detect in the materials collated, it is believed that the table yet gives, what is designed, a correct general idea of the relative temperature of the several posts of observation.

In regard to the meteorology of Western Asia, one or two prominent peculiarities are worthy of special notice. During a period of several weeks in the warm season, rain is rarely or never known to fall. In Syria this period embraces the months of June, July, August, and September, with but little rain in May and October. At Mosul the dry season commences a month earlier than this, and at Erzeroom a month later, but in its termination there is not observable the same disregard to simultaneousness. The other places from which we have records, (Oormia excepted,) although exposed to a long dry season during the summer, are scarcely ever, owing to their relations to large bodies of water, entirely destitute of showers for a whole month at a time. The summer of 1845 has been remarkable for excessive drought in Asia Minor and the neighboring part of Turkey in Europe; so excessive, indeed, as to prove fatal to a large proportion of all the crops on the ground, and to lead the Sultan to prohibit exportations of grain from the affected region, lest the consequence should be extensive famine and suffering during the ensuing winter.

All of the places recorded in the table, are subject more or less, at all seasons of the year, to siroccos or hot and dry winds, which bring with them, as is supposed, the climate and temperature found over the interior and extensively desert country. These winds sometimes prevail for several days together, in which case they never fail to produce an excessive languor and lassitude. At Mosul, the air at such times is filled with particles of sand, and however close one may shut up his apartment, he will be notified of the existence of the wind, by the oppression of his breathing, and by the deposit of this fine sand around him, and in every crack and crevice to which the air can find access. May it not be that the effect produced upon animal life by this wind, is in all cases to be attributed as much to inpalpable substances which it brings into the lungs, as to its heat and the quantity of moisture which it abstracts from the body. The peculiar color of the air during some siroccos can hardly be accounted for on any other supposition. By carefully comparing the registers from which the abstracts were prepared, it is found that these winds visit at the same time, all those parts of Asia Minor which are reported. As the highest temperature of each month generally takes place during the sirocco, if one occurs, it has been attempted to present some evidence of this simultaneousness by noting in the first table the *date* of the highest temperature of several months of 1844 and '45. March, April, May, June, July, and August, 1844, and February and March, 1845, may be referred to as well marked cases of this kind. Those instances however which appear exceptions in the table, are not in fact exceptions to our remark, since during the sirocco the highest heat of the month may not occur: e. g. Feb. 29th, 1844, gives us 62° as the temperature of Trebizond, and July 21st of the same year, though not the warmest day of that month in Broosa, was yet nearly so, the temperature being 92°. In the northern part of Asia Minor the sirocco ordinarily blows from the south; in Cyprus, I am told, it as regularly blows from the north; but in Syria, as the records show, no such uniformity of direction seems to exist. It may come from N. E., E., or S.

With respect to the peculiarities of climate at the several places in which the records collated in the tables were kept, the remarks which follow are designed to be brief, and to touch only upon

the most important features of each, as they would strike an observer moving consecutively from one place to the other.

At Erzeroom, we find, as might be expected from a place in the latitude of 40°, and more than a mile above the level of the sea, a cold winter and relatively cool nights throughout the whole year. The heat of summer, more particularly of the middle of the day, is however less modified by the circumstances of latitude and elevation than one would suppose from the mention of these particulars alone. The extensive and nearly barren plain, which stretches for several miles north and west of the city, has undoubtedly much to do in counteracting the causes of cold which exist there, as in places similarly elevated. A remarkable freedom from wind, which occurs during the winter season, serves greatly to diminish the amount of sensible cold, and a person may sometimes be in the open air when the mercury is very low, without being at all sensible of the extreme cold indicated by the thermometer. As it is natural to associate clouds and storms with mountainous regions, the dry season of Erzeroom, though not so long as that of Syria and the region of Mosul, is a feature of its climate well worthy of mention. None of the gardens and fields around the city, nor indeed any where upon the plain, are expected to bring their productions to maturity without being watered by artificial means. This remark is supposed to be true very generally of all Turkey in Asia not lying on the declivity which looks toward the Black sea. It is true emphatically of the mountainous region south of Erzeroom, as the writer had occasion to observe when in the country of the Mountain Nestorians in 1844. There none of the lands are considered tillable, except those lying on the borders of streams or where the waters of a spring may be made to flow over them. The dryness of the soil arises not only from the infrequency of rains, but also from the great want of moisture in the atmosphere, there being no large evaporating surfaces like those of our large rivers and inland lakes. In consequence of this, the air needs only to be slightly elevated in temperature, and it becomes greatly undercharged with water. The nearness of the Black sea does little to supply this want, since it is skirted along the whole southern shore with mountains so high as to prevent, to a great degree, the passage over them of the moisture raised from its surface. In travelling over, and along the sides of these

mountains, I have been struck day after day and week after week with the difference observable in the meteorology of their two sides. Towards the north, fogs and clouds, and towards the south, a clear and blue sky, were the almost universal order of the day. Early in the morning indeed, the view from the mountains towards the northern horizon is sometimes singularly clear; but low beneath the feet of the observer, a vast sea of clouds stretches before him, and he rarely gets a glimpse, of what he so much wishes, the distant Euxine as first seen by the "Ten Thousand" in their signal retreat. In a short time after the sun rises, the clouds begin to creep up the declivity facing the north, and soon afterwards, attaining the summit, they pour over it towards the south, presenting a white sheet along the mountain ridge not unlike that of the brow of our own Niagara. The destination of the vapory cataract of these high regions is however very different from the one of water which it so naturally suggests. Hardly do the clouds pass these mountain summits before they begin to melt away and disappear in the arid atmosphere, which waits to receive them. Rarely, very rarely, during the summer months, does a north wind prevail so strong as to carry the clouds unbroken over an extended space so far in the interior as Erzeroom. It is only when the season advances, as in October or November, and when the temperature is such as to give the atmosphere a greatly decreased capacity for moisture, that the cloudy, damp, and stormy weather of other mountain regions begins to prevail and the rainy season sets in.*

Trebizond is remarkable for the equable nature of its climate as to temperature, and for the predominance of moisture in its atmosphere, compared with other places mentioned in the above tables. By the abstract in the last of these, it will be seen to present a less range between the extremes of a year, than any other place besides Beirût. If however the average daily range had been taken as a standard of comparison, the result would

* Exceptions of course occur in every climate, and one that took place in that of the plain of Erzeroom during the last season is worthy of mention. On the nights of June 21st and 22d, the writer travelling with a company in tents, encountered a snow storm, (about eight miles west of the city,) which left the ground over the entire plain and the surrounding mountains, covered with snow six or eight inches deep. It was said that few persons living had ever witnessed any thing of the kind, and the Mussulmen made it the occasion for offering special prayer in the mosques.

have been much more striking in favor of the equable temperature of Trebizond, the average daily variation for the year, as thus obtained being 5°, while that of Beirût the one which approximates most, is about 65°. The great moisture of the atmosphere is observed in the tendency of every thing to rust, mould, or acquire dampness, even in the most favorable situation, where not exposed to the direct rays of the sun. The amount of rain which falls at Trebizond, and the great proportion of cloudy weather are also striking features compared with other parts of Turkey, and the remarks made in the preceding paragraph will furnish obvious reasons for these peculiarities. Its situation on the shore of the Black sea, hemmed in behind by mountains, and having a prevalent wind from the water, either in the form of a sea breeze or otherwise, are the causes referred to. Only eighty-three out of two hundred and sixty-eight records made in June, July, August, and September, 1843, and only one hundred and seventy-two out of three hundred and thirty insertions in the register for the same months of 1844, were *clear*, and these months, it is to be remembered, include that part of the year when a clear sky and dry atmosphere most prevail at all the other of our posts of observation. It has been remarked by one of the observers at Trebizond that the ordinary rules for predicting changes of weather from the state of the barometer, do not seem to hold true at Trebizond, but we unfortunately have no such records as will enable us to present the facts now alluded to. Doubtless the vicinity of mountains and the peculiarity of the winds must be the ground of the exceptions referred to; as they are found likewise to effect equally strange and sudden changes in temperature: e. g. March 10th, 1844, we have the thermometer 71° at sunrise and 58° at 2 P. M.; and Feb. 16th of the same year, 48° at sunrise, 37° at 2 P. M., and 45° at 9 P. M. It may be well also to remark that Trebizond is less affected by the sirocco than any other of the places where meteorological tables have been kept.

Constantinople.—The climate of the capital of Turkey furnishes little that is sufficiently striking to merit notice in this brief account. Its situation on the Bosphorus, and between the Black sea and sea of Marmora renders it peculiarly exposed to northerly and southerly winds. On looking over the daily observations of a year, I find the northeasterly winds most prevalent, and that

during the whole time there were but two instances of the winds blowing directly across the straits for the entire day, in one of which it was from the east, and in the other from the west. The mildness of its temperature during the winter, is greater than that of the same latitude in the United States, and it is very rare to have any considerable fall of snow; but at the same time there are enough cold rainy days to make the weather on the whole seem more chilly than the bracing air of New England. During the summer there is less of rain and a greater proportion of warm pleasant weather than is enjoyed by the Middle and New England states, but ordinarily there is enough rain to bring grain to maturity without artificial irrigation. There is a common saying here, that one must keep his best fuel until March, and it is observed by foreign residents, that although spring seems pretty uniformly to open in February or the first of March, with fine weather, there are after this, several days if not weeks of the most uncomfortable chilly weather of the whole year.

Broosa.—The inland situation of Broosa, and its location at the foot of Mount Olympus,—which is 7000 feet high and preserves snow on its top throughout the entire year,—causes a greater annual range than exists at any of the sea-ports from which we have records, though not so great as that of Erzeroom, Mosul and Oormia. The effect of the sirocco is more trying and oppressive than at either of the places already mentioned, and I should think from my limited observations, that this wind there, is for some reason, peculiarly frequent. Witness the highest temperature as recorded in the first table for March, April, and May, 1845, and for June, July, August, September, and November, 1844. Still Broosa is considered a very favorable climate for invalids, and crowds of people flock there during the summer to recruit their health at the *natural* hot baths with which the vicinity of the place abounds.

Smyrna.—The annual range of temperature at Smyrna is not very great, but the average daily range, 14°, is wider than that of any of the other places from which we have observations. Its winter consists in a damp, rainy season, and is rarely marked with slight falls of snow; but Americans who arrive here from Boston during this portion of the year, uniformly feel more inconvenience from cold than during previous winters at home, but whether this may not be mainly owing to the change experienced on leaving

the sea, is a reasonable question, to settle which, facts are needed that we do not yet possess. The summer of Smyrna is warm compared with that of any of the aforementioned places, and on this account, it is the more to be regretted that our records from this place are deficient for the months of July and August.

Beirût.—The warm climate of this place is what might be expected from its latitude; and the slight annual range of temperature, from its fine exposure to the open sea, from which the wind prevails at all seasons of the year. The force and constancy of the southwest wind is such as to be constantly making its impress upon the land; the sand rolled up by the sea, is raised into the air and driven in such vast quantities into the interior, southeast of the city, as to form there, high ridges, which by gradual advances of a few feet each year, are covering up trees, gardens, vineyards, and even houses themselves when they are not removed in anticipation of the calamity.

Mosul.—No one can cast an eye at the records of this place, without being struck with the extreme heat of the weather during the summer months. So excessive indeed is the temperature that it will not be strange if some of the readers of this article are incredulous with regard to the accuracy of the observations, from which the above abstract was made. But the writer may state, that before the place of observation was fixed upon for the summer of 1844, three thermometers were suspended several days in succession, in the most eligible situations in the house in which he then resided, (a house favorably situated too, it being on the highest ground in the city,) and that among these a place was chosen, which, while it was not affected by the confined air of the court, was also in no way exposed to the direct rays of the sun, and as little as possible to the reflected rays. Moreover, the opportunity was afforded of occasionally comparing the temperature thus given, with that of a thermometer suspended in a good position, at the country residence of the French Consul, among the ruins of ancient Nineveh (?), and there is therefore every reason to believe, that local causes had very little effect on the mercury of the thermometer with which the record was made. The temperature at 9 o'clock P. M., strongly corroborates this, as does also the fact that the removal of the thermometer into the sun at noon, would always cause the mercury to rise at once to 144° or 146°. On account of this excessive heat, all who are able, have rooms

fitted up in their cellars, where they retreat to spend the middle of the day. The nights are uniformly spent on the flat roofs, dew and rain being wholly unknown during the summer season. One peculiarity growing out of this extreme heat of the climate, was often the subject of our remarks. Contact with every thing dry communicated the sensation of heat, our beds seemed to have been just scorched with a warming-pan, and stone floors appeared as if endowed with the power of generating caloric., Instead of being refreshed by the cooling sensation which a change of clothes ordinarily gives in the summer, the linen taken out of our coolest wardrobes seemed always, on putting it on, to have come roasting hot from the mouth of some glowing furnace.

Respecting Jerusalem and Oormia, not having visited those places, we are unable to give, according to the plan pursued with regard to the other points from which we have records, any prominent meteorological peculiarities which might not be inferred from the above tables. A great tendency to intermittent fever is known to exist on the plains of Oormia, and may be mentioned as one peculiarity of the climate of that place as a mission station. The cause of this is no doubt to be found, either in the miasmata of the city or the exhalations from the great lake which bounds those plains on the east.

From observations made for several years by the missionaries resident in Beirût, Trebizond and Oormia, it has been found that by leaving those cities for the mountains near at hand, during the summer months, they obtain a healthier and far more pleasant place of residence. This has led to a careful comparison between the temperature of the plain and the places of resort on the mountains, and in neither of these cases does the average variation exceed 7° or 8° Fahrenheit. Still, the variation in one's feelings is very manifest, even in ascending four or five hundred feet. While, on the plain the parched and sultry air of a summer's day seems almost insupportable, the breeze of the upper strata of air seems to refresh and revive the spirits, and to infuse new life into the whole system. "What is the cause of this effect on the physical frame?" is yet a question open for investigation. Would the residents at Oormia be refreshed by a sudden removal to the sides of Mt. Lebanon, or to the hills back of Trebizond? If so, as such a removal would bring them two or three thousand feet nearer the level of the sea, it is plain that the effect is

not produced, as is commonly supposed, by the diminished pressure of the atmosphere in elevated regions. Without doubt, differences in the electrical state of the air, will yet be found a fertile cause of various modifications in the working of the nervous system, but as we have thus far been unable to obtain any facts of this kind in respect to the cases now referred to, we must leave the question they suggest where we found it.

It remains only to mention the individuals whose kindness and interest in meteorology has enabled us to present to the public the above tables. James Brant, Esq., English Consul at Erzeroom, furnished the records for that place for 1835, 6, 7, and 8, and for Trebizond for 1838 and 9; Rev. Messrs. E. E. Bliss and N. Benjamin, those for Trebizond for 1844 and 5; Rev. P. O. Powers those for Broosa for 1844 and 5; Rev. C. Hamlin those for Bebek; Rev. H. G. O. Dwight those for Pera; Rev. S. H. Calhoun those for Smyrna; Rev. J. F. Lanneau those for Jerusalem; Dr. H. A. DeForest those for the other places in Syria; Rev. Thos. Laurie those for Mosul prior to April 4844; and Mrs. A. H. Wright and Miss F. Fiske those for Oormia.

ART. X.—*Facts relating to the Great Lakes;** by Prof. C. DEWEY.

1. *Phenomenon on Lake Ontario.*

ON September 20th, 1845, was witnessed a singular phenomenon on Lake Ontario. In the afternoon *the waters suddenly moved, in a mass, out of the rivers, bays, coves, harbors, &c.*, lowering the water to different depths in different places. In ten or twelve minutes the waters returned, and rose to a higher level than they had before. This oscillation or efflux and reflux of the waters was repeated several times at about the same interval of eight to twelve minutes. At the mouth of the Genesee river, seven miles from this city, the water fell two feet below its common level, and soon rose as much above it. The Revenue Cutter, John Y. Mason, lay in the harbor, and the hands witnessed the fall and rise of the waters. At several places along the neighboring shores, boats were left for a few moments on the sands. At Oswego, seventy miles east of this, a large body of logs mov-

* Originally printed in the Report of the Regents of the University of New York, for 1846, p. 228, nearly as prepared for this Journal by the author.

ed out into the lake, to the great annoyance of the owner, till he saw them soon returning to their previous location. At Cobourg, a *little west of the Genesee*, and on the Canada side of the lake, and *distant about sixty miles*, the same fall and rise were observed to be repeated, the greatest being a little before sunset, when the waters rose to their highest point or about two feet. In the efflux the shores had in many places been left dry for some minutes. At Port Hope, a few miles west of Cobourg, the steam-boat Princess Royal, ran aground as she attempted to enter the harbor, so much had the waters lowered in the port.

The cause of this phenomenon is doubtless to be found in the tornado which passed that afternoon over the lake, beginning at Johnston's Creek in Niagara Co., and passing in a northeast course over Orleans Co., till it struck the lake at Oak Orchard Creek, fifty miles west of Rochester, and continued its course across the lake. The tornado was about three fourths of a mile wide in Orleans Co., and was very destructive, twisting off, and bearing away large trees, unroofing and destroying buildings, &c. Its violence was of only few minutes duration, perhaps not over three. On the lake, it produced water spouts and was attended with large hail, and lightning and thunder. The steam-boat Express, Capt. Mason, was in great jeopardy from the wind and waves and storm, as she was then passing up the lake on her regular trip. The power of this tornado, was probably sufficient to withdraw the waters from the shores so as to produce the efflux and reflux that was witnessed. Such sudden changes of the level of the waters, are said to have been witnessed before on the lakes. The solution in this case may apply to the whole. It seemed desirable to collect and connect the facts in this case and to publish them, as they prevent a resort to supposed earthquakes, heaving the bottom of the lakes, or change of the level of the shores, of which not a trace is left and not a probability exists. This tornado does not appear to have moved rapidly, but to have derived its force from the great rotatory velocity, as it twisted off trees, breaking them more than overturning them. A lumber wagon was raised into the air and carried a considerable distance. A stick of timber, which required eight men to carry it, was removed to the distance of fifty rods. On the lake, large water spouts were raised, and a great body of water seemed to be elevated into the air. It passed over nearly the middle of this part of

the lake, as it was too far from Cobourg on the north side, and from Rochester on the south side, to attract any attention.

2. *Fall of the Water of the Lakes.*

It is well known that the level of Lake Ontario slowly descended through several months of last year. The collector of the port of Genesee, L. B. Langworthy, caused accurate measurements to be made at the mouth of the river, which have been continued by his successor. The level was considerably lower last summer than in several years before; and the level fell till the beginning of this year. About the first of March it began to rise, as shown by the following record from the collector's office.

				Feet.	Inches.
1845.	June	1,	water below top of wharf,	1	0
	Sept.	1,	" " " "	2	1
	Oct.	1,	" " " "	2	6
	Nov.	1,	" " " "	2	9
	Dec.	1,	" " " "	3	1
1846.	Jan.	1,	" " " "	3	4
	Feb.	1,	" " " "	3	4
	March	1,	" " " "	3	2
	April	1,	" " " "	2	9
	May	1,	" " " "	2	6
	"	21,	" " " "	2	3

The melted snows of March, and rains since, have made a rise of more than a foot.

The level of the water has been considerably lower than usual in Lake Erie, and at Detroit and in Lake Michigan, also at Niagara Falls. The same fact is doubtless true in Lake Superior. For the same reason has been operating over all the region of the great lakes. An uncommon drought for more than half of 1845 extended over this whole section. Of course, *far less water than is common, was poured into the lakes.* The cause of the fall is most obvious; and there can be no necessity for a resort to the notion of a regular and periodical rise and fall of these inland seas, or to a supposition of an actual sinking of the bottom of their outlets. While the drought extended over a wide extent of our country, the seasons were wet and rain was abundant in the western parts of Europe.

Rochester, N. Y. May 22, 1846.

ART. XI.—*On the occurrence of Fluor Spar, Apatite and Chondrodite in Limestone;* by JAMES D. DANA.

THE analyses of corals by Mr. B. Silliman, Jr.,* have shown that although ordinary corals consist mainly of carbonate of lime, there is present a small proportion of phosphates, and fluorides, with some silica, alumina and oxyd of iron. It is also probable, from some trials by Mr. Silliman, that these constituents exist also in many shells.

From the results obtained in these analyses, it appears that the fluorides and phosphates amount, on an average, to about ¼ per cent, or 0·25 parts in a hundred parts of coral; and the amount in the same manner of the phosphates, is 0·05 per cent. A cubic foot of coral, as deduced from the average specific gravity ascertained by Mr. Silliman, weighs 157 pounds.* Consequently in each cubic foot there are 6¼ ounces of fluorides, and 1¼ ounces of phosphates; in each cubic rod, 1700 pounds of fluorides, and 340 pounds of phosphates. These fluorides are fluorides of calcium and magnesium, and the phosphates are phosphates of lime and magnesia. In the same manner we ascertain that the amount of fluorides in a reef of coral, a mile long, half a mile wide and a hundred feet deep, amounts to more than 500,000,000 pounds. The proportion of silica is a little less than that of the fluorides.

Late geological researches have placed it beyond doubt, that the various limestones consist mainly, like coral limestone, of animal remains, among which corals, in many instances, hold a conspicuous place. These limestones often contain crystallizations of fluoride of calcium (fluor spar); and in other beds which have evidently been acted upon and crystallized by heat, there are also apatite (phosphate of lime), and chondrodite, (composed of fluoric acid, magnesia and silica). Moreover these are the most common minerals of these limestones.

The above deductions supply us with a full explanation of the origin of these minerals. The fluorine, phosphoric acid, lime, magnesia and silica present, are adequate for all the results, without looking to any other sources. Instead therefore of being extraneous minerals introduced into the limestone rock, their ele-

* See the volume of the Exploring Expedition on Zoophytes, p. 712; and this Journal, Second Series, vol. i, p. 189.

ments at least are an essential part of its constitution; and they have been separated from the general mass by a segregation of like atoms under well known principles, and it may be, arranged anew, in some cases, according to their affinities. Fluoride of calcium may crystallize out when under water, without much or any heat; and it is an interesting fact that this fluoride has been lately proved by Mr. G. Wilson, to be soluble, to some degree, in pure cold water.* Mr. G. Wilson has also shown that fluorides actually exist in seawater, as had been suggested by Mr. Silliman, some months before the discovery, in his memoir on the composition of corals. Apatite and chondrodite require heat, as they are found only in *granular* limestones. The chondrodite is not supposed to exist as such in coral, but to form from the mutual action of its elements, (which are present) during the slow action of the heat that gives the crystalline character to the limestone.

The magnesia of magnesian limestones is not attributable to the corals, as the proportion obtained by the analyses is less than one per cent.† It is derived probably from a foreign source; and this may be true, in part at least, for the magnesia of the chondrodite, although there is enough of this constituent present for a large amount of this mineral. The silica may also be in part foreign, or may proceed from the earthy impurities which were mixed with the limestone at its formation.

New Haven, May 1st, 1846.

ART. XII.—*Description of a peculiar arrangement of muscles in the Glass Snake*, (Ophisaurus); by W. M. CARPENTER, A. M., M. D., Professor in the Medical College of Louisiana.

BOTH in the Old and the New Worlds, there are species of reptiles called Glass Snakes, (*serpent a verre*,) on account of their extreme fragility. These animals, belonging to different species, appertain however to the same group. The animal called by this name in Europe, is the Anguis fragilis of Linnæus, whilst in this country, several species of Ophisaurus are confounded, by the people, under this common name.

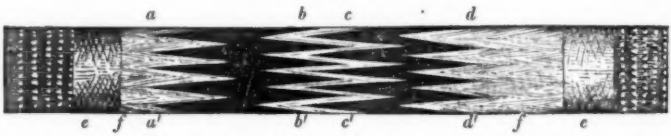
* See Chem. Gazette, No. 85, May 1846, p. 183; and *beyond*, in this volume.
† See this Journal, New Series, i, 189, 198.

These animals have the external form of serpents, but resemble the lizard family in general structure. They constitute the transition type between the Lacertian and Ophidian reptiles. The genus Ophisaurus owes its name to this circumstance, (*Οφις, serpent, σαυρος, lizard.*) It includes several species inhabiting the southern parts of the United States, principally the pine forest and prairie regions. They have about 150 vertebral bones, about one third of which belong to the body and two thirds to the tail; the body is consequently very short when compared with the tail.

All of the species receive indiscriminately the name of Glass snake from the extreme fragility of their tails. A very slight stroke with a small rod, or trifling violence inflicted by any other means, will cause the separation of a part of the tail from the body, and the tail will sometimes break into a number of pieces. The body and attached parts continue to live, and in process of time the lost portions are replaced by a new growth.

If we examine the parts separated, in an animal which has been thus broken, or what is preferable, drawn asunder, several little conical and pointed fleshy processes, may be observed, surrounding the vertebral bones, and projecting several lines beyond their articulating surfaces, and which must have been drawn out of cavities in the muscles, that correspond in position on the adjacent vertebral bones.

Fig. 1.



In figure 1, I have endeavored to represent an enlarged view of this appearance. Lines drawn across the figure from the points a to a', b to b', c to c', and d to d', may represent the position of the separated articulating surfaces of the adjacent vertebræ, which, when in their natural positions, would of course be in contact; and it is easy to see that when these are in contact, the conical muscles, which project so much beyond them, must fit into corresponding cavities of their own size, in the muscles corresponding in position with them on the next bones. If one of the vertebræ is examined separately from the rest while surrounded by its muscles, it will be seen that each vertebral bone

has a series of these muscular cones around each of its extremities, and projecting beyond its articulating surfaces, in a direction parallel to the axis of the bone; one set projecting forward and the other backward. Further examinations show that these two sets of muscles are connected together, and in fact that they are composed of the same fibres or fascicles, which, having slight attachments about the middle of their length to the bone, extend forward to form the anterior series, and backward to form the posterior series of conical muscles. Each of these cones is formed by the union of two sets of muscular fibres, which are slightly oblique to each other, and which meet at a very acute angle; and the same fascicles which, by their anterior projection, form the cone standing *forward*, are prolonged in the opposite direction, and by meeting with the oblique fascicle lying next to them, form the cones which project *backward*. Each of these conical muscles contains a conical cavity corresponding to its outward form, for the reception of the muscle next behind it. This arrangement I have endeavored to represent in the middle portion of fig. 1. Lines drawn from *b* to *b'* and from *c* to *c'*, would indicate the situation of the ends of the bone. The white lines which run a little obliquely back and forth, and meet to form the zigzag series, indicate the relative position of the different fasciculi of muscular fibres, which constitute the series of muscles that surround each of the vertebral bones. Each of the fascicles has a point of attachment to the bone near its middle.

In order to analyze the arrangement of these muscles and the direction of their fibres, it will be necessary to describe the bones around which they are situated.

Fig. 2.

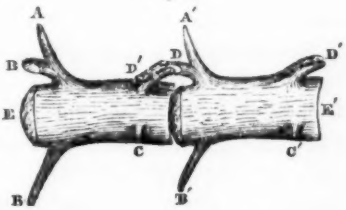
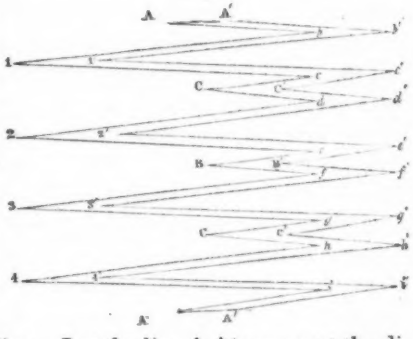


Fig. 2 represents an enlarged view of two bones in their natural position. The anterior articulating surface is concave, the posterior convex; they are covered with a smooth cartilage, and are susceptible of very free motion; they are represented by E and E'. A and A' are the superior spinous apophyses, between the crura of which passes the superior spinal canal, containing the spinal marrow. B and B' are the inferior spinous apophyses, between the crura of which passes the large artery. C C' are the

transverse apophyses—D and D′ are the oblique articulating apophyses.

These bones are but slightly attached to each other by ligaments. There are rudiments of capsular ligaments, which are very thin fibrous membranes surrounding the articulation; and there are a few fibrous filaments passing from one of the spinous apophyses to the other; but they are all so delicate that they would be altogether inadequate to hold the bones together.

Fig. 3.



In the diagram, fig. 3, I have attempted to show the relative situation and direction of the muscular fascicles which enter into the composition of the muscles, situated around two contiguous vertebral bones. Suppose the layer of muscles to be detached from the bone and spread out on the paper, beginning at the dorsal median line. Let the line A A′ represent the direction of this line, in which the points of the superior spinous processes are represented by the points A and A′. Starting from the spinous apophyses A and A′, the first fascicle on each side of the median line, runs obliquely forward and downward, and may be represented by the lines A*b* and A′*b*′, and are met at their anterior extremity by fascicles 1*b* and 1′*b*′; running with equal obliquity, forward and upward. The fascicles *b*1 and *b*′1′ are met at their other extremities by fascicles *c*1 and *c*′1′; and so on with the other fascicles which are thus connected, and may be followed on around until we get back to the starting points at the spinous apophyses, on the side opposite to that on which we commenced following this zigzag and continuous series. These fascicles have attachments near their middle to the bones, with the exceptions of those which are attached to the spinous and transverse apophyses, which have their attachments by one of their extremities. Thus in the diagram fig. 3, the points A A′, B B′, C C′, represent respectively the superior spinous, the inferior spinous, and the transverse, apophyses, and it will be seen that the fascicles start from them respectively.

Now each of the fascicles of this series being met at each of its extremities on alternate sides, by other fascicles at acute angles, unite with them to form the hollow little cones already mentioned. Each of these cones is received and exactly fits into the hollow of that which stands next to it in the direction of its point; and in turn it receives the point and body of that which stands next to it in the direction of its base. Each of these cones may perhaps be one third or one fourth as long as the entire fascicles of which it is composed.

Some of the fascicles being attached near their middle to the bones, have both of their extremities free, and it is by these free extremities that the conical muscles, in each direction, are formed; while those fascicles which have their attachment to the spinous and transverse processes, are attached by their posterior extremities, and from them project only forwards, and having only one free extremity, enter into the formation of only one set of muscles. The points of attachment which are in the middle of some of the fascicles, are common to both the anterior and posterior sets of muscles. The fascicles surrounding a bone have each a single point of attachment to that bone, and are not at all attached to any other bone; and the series of muscles surrounding a bone, has fibrous or muscular attachments to this bone alone, and has no fibrous attachments to any other tissues, excepting a very slight one on its contour, to a thin fascia which surrounds the series and binds it together.

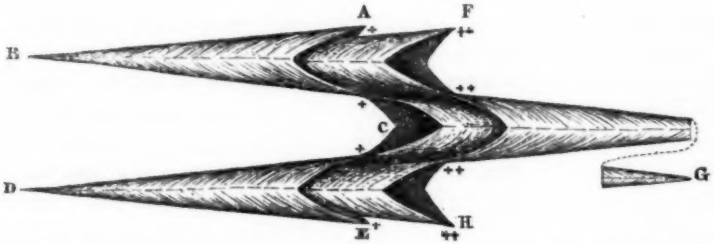
Fig. 4.

In fig. 4, I have endeavored to show the arrangement of the fibres in each of the fascicles, which, in the middle portion, is a flattish muscular membrane, and for a portion of its length towards each extremity, forms the lateral half, A and A′, of a hollow muscular cone, the concavity, in the two, presenting in opposite directions, and which meeting with other similarly arranged fascicles, completes the cones which stand in opposite directions. The fascicle is attached to the bone by the middle at B.

In fig. 5, I have endeavored to exhibit the manner in which the systems of muscular cones, connected with two contiguous bones, mutually receive and are received by each other. The

muscular arrangement A B C D E, belongs to one bone, while the arrangement F G H, belongs to the adjacent bone. The points of attachment of these two muscles to their respective bones, may be represented by the points * and **. The cones F and H, of the muscles of one bone, fit into the cones A B C and C D E of the other, while the cone C of the latter, fits into the cone G of the former. Thus the muscular cones of the successive bones, mutually invaginate into each other, where they are retained, not by fibrous attachments, but merely by fitting nicely into each other, and by the harmony of their contractions one upon another.

Fig. 5.



The muscles in their natural position, surrounding the bodies of the bones, form the fleshy cylinder of the animal, as at *f*, fig. 1. This is surrounded by a thin fascial sheath, which lies immediately under the skin, as represented at *e*, fig. 1, and which constitutes the principal means by which the bones and muscles are held together in the direction of their length; as the skin, though forming rather strong rings around the body, separates easily into these rings when force is applied in the direction of the length of the animal.

This animal is not only easily broken by blows, but has likewise the power, when caught, of casting off the part of the tail which is held. It is also said that the Anguis fragilis of Europe, possesses the same power. This power may be accounted for, by supposing the animal capable of exercising separate and distinct control over the contractions of each of the muscular cones. This being the case, if the animal contract all the invaginated cones belonging to a bone, and does not contract the invaginating cones, it is evident that it would cause a partial loosening and drawing out of the invaginated cones; and as the cohesion of this invaginated arrangement seems to be one of the principal forces that holds the different segments together longitudinally,

these would then separate at the point where this force is removed.

It is a popular error which supposes that the separated joints or segments reunite, and that they will come together even if separated to a considerable distance. The spinal marrow and large artery run through the entire length of the animal, the former occupying a canal which passes between the crura of the superior spinous apophyses; the latter in one which lies between the crura of the inferior spinous apophyses. In separating the bones from one another, these important organs are of course broken, and the death of the separated segments is an inevitable consequence. The animal, however, acquires a new tail by growth. When first healed the animal ends in an abrupt truncation, which is covered with small scales, arranged in concentric circles around its centre; but in course of time, this truncated extremity begins to receive a conical shape, which gradually takes a more projecting and tapering form, the circles of scales then assume the position of rings, which surround and cover it; and by slow growth the tail acquires about its wonted length.

This arrangement is interesting, principally, from being a new form and application of the muscular structure. Notwithstanding the modifications which the muscles undergo, in assuming this arrangement, we may fix upon the particular muscles of which the fascicles are formed. The muscles which form these fascicles are, principally, the interspinales, the longissimus dorsi, the inter-transversales, and some others.

ART. XIII.—*Observations on the more recent researches in the Manufacture of Iron, (continued;*)* by Dr. J. LAWRENCE SMITH, of Charleston, S. C.

IN the last article on this subject, the operations of the blast furnace alone were alluded to, and among the statements then given, was that of the composition of the gas taken from the mouth of the furnace; which gas contained about 24 per cent. of carbonic oxide, this representing a large portion of the combustible used, which is lost in most of the furnaces now in operation in this country.

* See this Journal, Second Series, i, 170.

M. Ebelman states that the combustion of the gas passing from the mouth of the blast furnace is equal to from $\frac{62}{100}$ to $\frac{67}{100}$ of the calorific effect of the coal used, and MM. Bunsen and Playfair set it down as $\frac{90}{100}$, which last I am inclined to believe is rather too large a fraction; they spoke of the furnace worked with bituminous coal, and Ebelman had allusion to one worked with charcoal. Without being able to decide exactly what portion of the combustible of the blast furnace is lost, it is sufficient to know that it is far greater than that consumed, to lead at once to the employment of means bringing into use this waste combustible.

The employment of the heat lost from the mouth of the blast furnace, for the purposes of metallurgy, &c., has been claimed by many as having been used by them since 1834. The following are some of the claimants:—MM. Thomas and Laures, (civil engineers); MM. d'Andelarre and de Lisa, (forge masters at Treveray); M. le Marèchal Marmont, (in Austria); M. Houzeau Muiren, (of Ardennes; and M. de Faber Dufaur, (of Wasseralfingen). All their claims of priority, however, ought to be laid aside, since the operation was performed many years prior to the time that any of them claim to have first employed the lost heat. And as a proof of this assertion, I give the following extract from the Journal des Mines, Juin 1814.—"M. Aubertot of the department of Cher, and owner of furnaces and other works in excellent condition and management, which he superintends personally, made, several years ago, a great many experiments to discover some means of economizing the amount of fuel used in the working of iron, either by endeavoring to introduce the operation by the catalan furnace, or otherwise. He was led to try what could be accomplished by making use of the flame which passed out of the blast and refining furnace. He first employed it for the cementation of steel, in which he succeeded perfectly; then he used it for calcining lime, also for burning bricks and tiles. Afterwards he passed it into a reverberatory furnace, in which the temperature was raised sufficiently to heat the blooms and bars, for hammering the one and drawing the other out. Finally he succeeded in producing all the above effects at one and the same time, by causing the flame to circulate through several furnaces side by side."

In 1834, M. Houzeau Muiren took out a patent for using the waste heat from the mouth of the blast furnace, for carbonizing

wood at the furnace of Bievres (Ardennes); in which he states that twice the quantity of charcoal is obtained by treating the wood after his method, than by the ordinary way of burning in the woods. By the heat lost from the furnace, 100 parts of wood gave 35 of charcoal, and from 40 to 45 of *charcoal roux* (half burnt wood).

But after all, it is not to those who first applied this lost heat to economical purposes, that we are indebted for the practical information that is now in our possession; for had they made their arrangements so as to exhibit an undisputed advantage arising out of its adoption, it would not have been so tardy in its progress.

It is to M. de Faber Dufaur, superintendent of the iron works at Wasseralfingen in the kingdom of Wurtemburg, that most of the credit is due for the present method of converting pig into wrought iron, by using and burning the gases that escape from the mouth of the blast furnace. The best idea that can be given of the manner in which the operations are conducted in the above works, and the advantages accruing therefrom, is contained in the following short extract from a letter written by M. Grouvelle to M. Dumas.*

"The establishment at Wasseralfingen is supplied with ore, three-fourths of which is a hydrated oxide of iron, and the other fourth is an ore in grains. The influence of the first species of ore gave to the pig so bad a quality that it was used altogether for castings. M. Dufaur, by his processes, without altering the operations of the blast furnace, now obtains from the pig a wrought iron of superior quality.

"The first gas furnace put in operation by him was a refining furnace, into which the pig metal was run as it issued from the blast furnace, where the refining was executed with the air of the hot blast. From this the most beautiful results were obtained, and it worked regularly during the year 1837. In 1838 he erected a puddling furnace; and finally in 1839 he completed his magnificent system for the fabrication of iron, by constructing a furnace for re-heating and welding."

At Wasseralfingen there are now turned out annually, one million pounds of wrought iron in various forms, made in these new furnaces, and owing to the deficiency of moving power, all the pig cannot be worked up. This operation of refining iron

* Comptes Rendus, 1841, p. 382.

by the combustion of gas without any other fuel, has been in successful operation at the above locality for several years, and it has been followed with a great improvement in the quality of the iron and has reduced the loss to one fourth of what it was originally.

This method of refining the pig has also been in active operation in a number of places, and whenever properly executed, is always attended with economy and success. M. d'Andelarre, in one of the departments of France, in a letter states, "our puddling furnaces, heated altogether by the gas lost from the mouth of the blast furnace, has been attended with the most complete success, which rarely happens in the first attempts at the application of any improvement, which most generally require long experience. We lighted up our furnace on the morning of the 5th, and put in the first charge at 11 o'clock on the morning of the 6th, and shingled the same at three-quarters past 12. The accomplishment of the results so quickly passed our expectations, resulting in

"1st. An economy of the total amount of fuel used in the refining of iron, (which, in a furnace with two doors, amounted, in twenty-four hours, to 6,000 pounds bituminous coal, costing twelve dollars.)

"2d. Improvement in the quality of the iron.

"3d. The loss was very small, being 5 instead of 20 per cent., which it is by the old processes.

"4th. The operations of the furnaces are much improved."

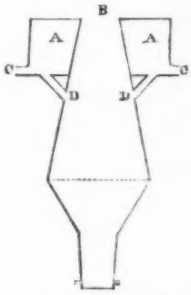
Here we see that the experience of M. d'Andelarre accords exactly with that of M. Dufaur, and already have Russia, Prussia, Sweden and Germany sent commissioners to Wasseralfingen, to study the processes as they are there carried on. The government of Wurtemburg have opened their works to the inspection of all who may wish to make themselves acquainted with their character.

The advantages arising from the employment of the waste gas from the mouth of the blast furnace, is no longer problematical, and as some of those interested in this matter may not be acquainted with the method by which the gas is collected and employed, a few words explanatory of it will not be out of place.

The gas, as it rises through the fire room of the furnace, containing from 60 to 80 per cent. of the combustible effect of the

fuel used, is made to pass into a chamber surrounding the upper and outer part of the fire room, some idea of which may be formed by the representation in fig. 1. B, is the mouth of the furnace; A A, gas chamber surrounding the upper part of the fire room; D D, pipes connecting the fire room and gas chamber; C C, pipes to carry off the gas, which is drawn out by means of blowing cylinders and forced into the refining, puddling or other furnace, through a number of small orifices alternating with other orifices, through which a cold or hot blast of air is thrown, that serves to keep up the combustion of the gas when once united; and by regulating the supply of air by means of stop-cocks, the maximum of heat can be obtained. In order to arrive at the maximum of heat, just sufficient air should be admitted to burn all the carbonic oxide and hydrogen contained in the gas coming from the blast furnace. If the amount of air be too small, some of the combustible gases pass out unconsumed; if too great, the excess cools the furnace, and at the same time oxidizes the metals undergoing refining. The regulation of the supply of the blast is of the utmost importance, and is said to be easy of accomplishment.

Fig. 1.



The differences between the reverberating furnaces worked in this way and those in which coal is used, is that carbonic oxide with a little hydrogen is the fuel, and it is burnt by a full supply of air. It is hardly necessary to say more of the advantages that are to arise out of this important change in the working of iron; for there is no expense for fuel in the refining of the pig, as the gaseous combustible issuing from the mouth of the blast furnace is more than sufficient to refine all the pig made from the furnace. The quality of iron is also improved, as none of those impurities contained in the coal and other fuel can interfere in the working of the iron.*

The sooner these modifications are introduced into our furnaces, the sooner will we be able to place iron in the market at a price to compete with that coming from any other quarter of

* If I mistake not, the Dufaur patent has been taken out in this country by Mr. Detmold, and has already been applied to one or two furnaces.—J. L. S.

the world, and entering our ports free of duty; at the same time it will increase the value of those works whose wood-land has been diminished by a too rapid and improvident use of fuel.

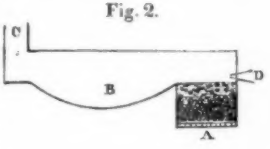
I next pass on to make a few remarks about the *refining furnace* used in the working of iron. In these furnaces the air is thrown by one or two tuyers, into a crucible filled with charcoal, into which the pig to be refined, along with scraps coming from previous operations, is placed in a certain relative position. The changes that take place by the reaction of the air upon the coal, is similar to what occurs in the lower part of the blast furnace, namely, the conversion of the oxygen into carbonic acid, which is immediately changed into carbonic oxide. The analyses of the gases taken from the centre of the furnace, prove that the transformation of the oxygen into carbonic acid corresponds to the position where the workmen constantly place the iron that is about to be forged, and this is just what we should expect as it is the point of maximum temperature.

Ebelman states that the atmosphere which surrounds the melted iron, contains hardly a trace of carbonic acid, either in the blast or puddling furnace; this being contrary to the opinion which is generally admitted, that the decarbonization of the iron takes place by the action of the air during the melting of the pig, but it would appear that this reaction is attributable to the protoxide of iron covering the surface of the mass undergoing refining. In the second period of refining, in the puddling properly speaking, it is easy to deduce from the analyses of the gas, that there is oxidation of a considerable portion of the iron by the oxygen of the air thrown in at the tuyer.

Here again much of the fuel passes off under the form of carbonic oxide, thereby causing considerable waste. Of late years a modification has been introduced into the refining furnaces, even when the waste gases from the blast furnace are not employed; a modification by which none of the combustible is lost. A few words will suffice to explain how this is accomplished.

All the furnaces are modifications of the reverberatory furnace. The fuel is placed upon the grate A, (fig. 2,) and ignited by air thrown in from below the grate, by a bellows or otherwise. The air in traversing the ignited coal

Fig. 2.



is first converted into carbonic acid, and then, if the bed of coal be thick enough, this last will be changed into carbonic oxide. As this however is generally not the case, a part of the carbonic acid passes beyond the upper surface of the fuel without having undergone a change, particularly if the blast from below has been strong and abundant. By this operation the chamber B becomes heated, and a mixture of carbonic acid, carbonic oxide, nitrogen, and a little hydrogen passed out of the flue C. The object of the metallurgist, however, is not to permit any carbonic oxide or hydrogen to escape combustion, but to endeavor to add to the heat of the furnace, that heat arising from the combustion of these two gases. This is readily accomplished by throwing in a second blast of air, through a number of small orifices just above the surface of the fuel, D; this blast to be regulated as required.

By this process we re-create, as it were, the maximum intensity of heat (which first shows itself at the lower part of the fuel on the grate, just where the air becomes converted into carbonic acid,) and in the chamber B, where it is most wanted; for the amount of heat rendered latent by the reduction of the carbonic acid into carbonic oxide, is rendered sensible by the reproduction of the former.

The advantages arising from this method of burning the fuel, are important. In the first place, the heat is diffused over a larger space, thereby heating more uniformly the metal, than when it is placed in the midst of the fuel. Again, fuel of the most inferior quality can be made use of, and as evidence of this in some trials made at Audincourt, it was proved that the reverberatory furnace could be heated to whiteness by burning the gas, and the pig melted and puddled, when a mixture of charcoal dust and earthy matter was made use of as fuel.

Ebelman, whom I have so often quoted in these articles, and who has certainly made the best series of scientific researches upon the subject, says that instead of employing the action of air upon an excess of charcoal to produce the combustible gas, the vapor of water may to an extent be substituted, which produces, in contact with burning charcoal, carbonic oxide and hydrogen.

The heat of the combustion of equal *volumes* of hydrogen and carbonic oxide is about the same, and it can be easily deduced that the decomposition of the vapor of water by the charcoal, determines an absorption of latent heat, equal to that which is pro-

duced by the transformation of the same volume of carbonic acid into carbonic oxide. The vapor of water alone passed through the ignited coal produces all the effects just mentioned, but the absorption of latent caloric is so great as to cause the operation to cease in a few minutes. By projecting, however, a mixture of air and the vapor of water through the coal, the operation is said to be carried on advantageously.

It was my intention to have remarked at length about the effects of the hot blast, but it is now so generally admitted that the hot is to be preferred to the cold blast in reducing the iron from the ore, and bringing it to its most refined state, that any thing on the subject at this time would be superfluous. All that is important to make known upon this subject, is the results lately arrived at by M. Scheerer* as to how it is that hot air produces such remarkable effects in the blast furnace.

By calculations based upon his own experiments as well as those of others, he was led to the conclusion, that the most elevated temperature that charcoal could produce in burning in air, is 2571° Cent., which is that at which platinum melts. This temperature is situated in the middle of the space upon which the air is projected, and it goes on diminishing towards the exterior, so as to form a space for melting, the center of which is at 2571° and the exterior at 1550° Cent. When the hot blast is made use of, the temperature of the center does not change, but the portion heated to 2571° becomes more extended. The exterior of the mass which was at 1550° while using the cold air, acquires when the hot blast is employed, a temperature as many degrees higher as there is difference between the temperature of the two blasts; for instance, if the temperature of the air be 280° C., that of the exterior of the heated mass will be 1830° C.—if 300° C., the latter will be 1850° C.

Thus the influence that hot air exercises, is to extend the space of fusion, which is twice as great with the air at 300° C. as it is when the air is at 0° C.

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* Pogg. Ann. lix, p. 508.

SCIENTIFIC INTELLIGENCE.

I. Chemistry.

1. *Ozone.*—For some years, Prof. Schönbein, of Basle, has been engaged in experimenting on the cause of the peculiar odor developed by electricity; during the electrolysis of water, the oxygen given off is mixed with a small quantity of a volatile odorous substance; to this he has given the name of *ozone*. For some particulars of its production, see this Journal, Vols. xli and xlix.*

This substance he supposed to be a halogen body, analagous in its reactions and affinities to chlorine and bromine, and indeed it has many points of resemblance; it destroys vegetable colors, decomposes bromide, iodide and ferro-cyanide of potassium, and acts upon the metals.

He regarded it as constituting the base of nitrogen, which he supposed to be a compound of ozone and hydrogen, analagous to the chloride of hydrogen. He supposed it to be a secondary product of the electrolysis, and formed by the reaction of the nascent oxygen on the nitrogen of the atmospheric air dissolved in the water.

M. Schönbein was subsequently enabled to produce this body by purely chemical means; when phosphorus, at ordinary temperatures, is exposed to *moist air*, ozone is always generated.† This reaction is best observed by introducing into a large glass vessel, a piece of phosphorus one or two inches long, and sufficient water to partially cover it; the whole may now be exposed for 24 hours to a temperature of 68° to 75° F., when the air will be found very highly charged with ozone.

From its supposed nature as the base of nitrogen, this body has attracted considerable attention from chemists, and has been made the subject of much experimental research, as well as a great deal of theorising and speculation. It has been particularly examined by M. Marignac and Mr. Williamson.

The former chemist has shown that ozone is generated by the electrolysis of dilute sulphuric acid, independently of the presence of nitrogen; it being produced equally well in a vessel exhausted of air.‡ M.

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* See also, Schönbein Archives de l'Electricité No. 15. Tom. iv. pp. 333–454; No. 17, Tom. v. p. 11–23, and No. 18, Tom. v. p. 337–342. Marignac, 17. v. p. 5–11; besides other authorities quoted farther.

† The peculiar odor of phosphorus is probably due entirely to the formation of this new substance.

‡ In one experiment, water acidulated by sulphuric acid was decomposed in a vessel, from which the air was completely excluded. After the decomposition had

Marignac also instituted a series of experiments on ozone produced by chemical means; air was made to pass through a long tube containing phosphorus, and thus it became sufficiently charged with ozone for the purposes of experiment. He found that perfectly dry air is incapable of generating this substance, and also that air freed from oxygen by passing over ignited copper, produced no trace of it; but if a very little oxygen (insufficient to support combustion for a moment,) is present, ozone is produced with the same ease as in ordinary air. Pure oxygen, nitrogen or hydrogen alone, do not produce it, but if a small quantity of oxygen is mixed with hydrogen, ozone is formed with great rapidity, on passing the mixture over phosphorus.

Air impregnated with ozone looses entirely its characteristic properties, if passed through a tube heated between 570° and 750° F. This principle is absorbed by water, but not by oil of vitriol, ammonia or chloride of calcium. If the air is passed through a solution of iodide of potassium, it loses its odor, and the salt is decomposed with the liberation of free iodine. Some iodate of potassa is also found in the solution.

Ozone is readily absorbed by the metals. If the ozonized air is passed through a glass tube containing silver in a porous form, (from the decomposition of the acetate by heat,) it loses its peculiar odor, and the silver is converted into a blackish brown substance, which, when thrown into water, gives off oxygen gas with effervesence, and the remaining substance has all the characters of ordinary oxide of silver.

These curious results, many of which were previously obtained by Schönbein, prove that nitrogen is not concerned in the formation of this substance, and seem to show that these peculiar reactions are owing to oxygen in a loosely combined state.

Mr. Williamson's experiments confirm these observations, and go to prove that it is a compound of oxygen and hydrogen. In his experiments, the oxygen from the electrolysis of dilute sulphuric acid, was thoroughly dried by passing it over chloride of calcium; the gas thus dried, was passed through a glass tube containing metallic copper, and heated to redness; water was formed abundantly and condensed in the cool part of the tube, and this formation of water continued as long as the process lasted. From this it appears that water is formed by the reducing power of the metal. To remove all sources of error, the oxygen was evolved from the electrolysis of a solution of sulphate of copper, in whose decomposition no hydrogen is set free, the oxygen thus

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been continued for two or three days, and when more than one fourth of the liquid had been driven off in the form of gas, the oxygen was found to be as strongly impregnated with ozone as at the commencement of the experiment.

obtained possessed strongly the peculiar ozone odor. It was now passed over copper (obtained by decomposing the oxide by carbonic oxide,) heated to redness, and water was immediately formed as in the last experiment.

In subsequent experiments, the ozonized oxygen previously dried, was passed through a glass tube heated to redness, by which the peculiar odor was completely destroyed; to this an accurately weighed chloride of calcium tube was fixed, after the gas had been passed a short time, the tube was found to have increased perceptibly in weight.

When the ozonized oxygen is passed through water, it communicates to it the peculiar odor. If this solution is added to a mixture of starch paste and iodide of potassium, a blue color is produced; and when mixed with ferro-cyanide of potassium, this salt gives a blue precipitate with proto-salts of iron. Solutions of lime and baryta give, with a solution of ozone, a heavy and apparently crystalline precipitate.

Mr. Williamson states as the result of his experiments, that ozone is not produced by the action of air on phosphorus, but we cannot admit this, for several reasons. The results of M. Marignac were obtained by the substance formed in this manner, and many of the results obtained by him are precisely the same with those of Mr. Williamson; and these as well as others obtained, cannot be referred to the action of phosphoric acid.

Mr. Williamson's arrangement, which consisted of a tube containing asbestos, on which the phosphorus was deposited by sublimation, was such as completely to defeat the object in view; for although ozone is generated by the action of phosphorus on air, yet it is itself absorbed or decomposed, when brought in contact with a large surface of phosphorus; and this result would especially occur when the phosphorus was heated, as it must have been from the exposure of so large a surface. Our own observations also have shown that something distinct from phosphoric or phosphorous acids, is generated by this process, for after the air enclosed in the globe had been thoroughly agitated and allowed to stand some hours, in contact with a mixture of carbonate of lime and water, it still retained the peculiar odor, and the power of decomposing iodide and ferro-cyanide of potassium.

The conclusion which these gentlemen deduced from their experiments was, that the substance which presents these curious reactions is a compound of oxygen and hydrogen, containing more oxygen than water, and perhaps isomeric with the deutoxide of Thenard. This view was certainly consonant with their results, and indeed they appeared to be inexplicable by any other hypothesis. The oxidation of silver to such a degree, and the conversion of iodide of potassium into iodate of potassa, evince the existence of oxygen in a feebly combined and

very active state, while the formation of water by passing it through an ignited glass tube or over heated copper, show that hydrogen is also present. More recently, however, we have a memoir on this subject by MM. Louis Rivier, and professor L. R. de Fellenburg,* which contains many interesting facts.

In their experiments they passed for two hours a series of electrical sparks through a glass vessel containing humid air, and whose sides were moistened with a solution of carbonate of potassa. The air acquired strongly the peculiar odor of ozone; which, by standing some time, disappeared, and the liquid was found to contain *nitrate of potassa.* They then proceeded to examine the ozone produced by chemical means. The arrangement consisted of a tube *a* about three feet in length, in which were placed several pieces of phosphorus moistened with a little distilled water; to one end was adapted a recurved tube, dipping in a bottle *b* which contained milk of lime; by means of an aspirator *c* connected with the other tube *d*, the air was made to pass slowly over the phosphorus and through the milk of lime, at the rate of 10 litres in 24 hours. The ozone thus formed was absorbed by the alkaline fluid, which after 24 hours was removed. After filtration, it was evaporated to dryness, redissolved in distilled water, decomposed by carbonate of ammonia, and the resulting salt again decomposed by a solution of strontia, when it afforded a salt in beautiful needles, which gave the following reactions: with sulphuric acid and brucine, a reddish yellow, and with narcotine a red color; it destroyed the color of sulphate of indigo; rendered brownish-black the protosulphate of iron; its solution in water with pure hydrochloric acid, readily dissolved gold leaf, and from the solution, chloride of tin threw down the purple precipitate of Cassius; some of the salt mixed with bisulphate of potassa, and heated in a glass tube, gave off abundant red vapors, which promptly blanched indigo paper held in the tube.

They next proceeded to distill a portion of the acid liquor produced by the slow oxydation of phosphorus; a very gentle heat was applied, and about one third of the liquor distilled over; the vapors were received in a solution of strontian; at the close of the operation, this had lost its alkaline reaction; a little more strontian was added, and the whole evaporated to dryness; by re-solution and crystallization, a quantity of salt in fine crystals was obtained, weighing about one and a half grains. This salt gave the same reactions as that above, which must be regarded as decisive evidence of nitric acid; the test with gold, and above all the red fumes evolved by the mixture with bisulphate of potassa, place its nature beyond all doubt.

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* Archives de l'Electricité, No. 17, Tome v. 1845.

From these experiments they concluded, that the reactions attributed to ozone, are in reality due to the presence of a small portion of nitrous acid; and they found that air mixed with a very small portion of nitrous gas, acquired an odor similar to that of ozone, blanching turmeric, dahlia and indigo papers, and presenting generally the same phenomena as ozonized air. They supposed that the acid first formed is the nitrous, as pure nitric acid when very much diluted, does not render blue a mixture of starch and iodide of potassium, which reaction is readily produced by the nitrous acid; and that the nitrites formed are converted into nitrates by the absorption of oxygen during the subsequent evaporation.

These experiments seemed to show, that a close relation certainly exists between nitric acid and ozone, and many chemists were disposed to regard them as identical; but the late researches of M. Schönbein* have cleared up to some extent the difficulties which seemed to envelop the subject.

M. Schönbein has suggested, that when water acts on hypo-nitric acid, there is formed besides hydrated nitric acid, a compound having the formula NO^2+HO^2, and which he calls the peroxide of azote and hydrogen. It is to the presence of this in the solution of hypo-nitric acid, that we are to attribute its remarkable powers of oxidation. The same reaction takes place when the hypo-nitric acid is introduced into a flask of moist air.

If having ozonized the air of a jar by phosphorus, we suspend in it a piece of carbonate of ammonia, till the air acquires the property of immediately blueing litmus paper, we shall find that it still retains all the properties of ozone—the peculiar odor, the power of decomposing iodide and ferro-cyanide of potassium. This body can then exist in an atmosphere of carbonate of ammonia, and also, as is found by experiment, in one of pure ammonia.

If we take a portion of hypo-nitric or fuming nitric, and dilute it with water till it loses its color, and having poured a small portion of it into a flask, suspend in the air of the flask a piece of carbonate of ammonia, till the air acquires an alkaline reaction, we shall find that it is capable of decomposing iodide of potassium, and blanching indigo paper, and even of converting a crystal of ferro-cyanide of potassium into the ferro-cyanide in the course of twenty-four hours; in fact it possesses all the properties of ordinary ozonized air. The circumstances under which these reactions are exhibited, do not admit of the view that the oxidizing agent is any acid of nitrogen, and hence M. Schönbein concludes that there exists the compound NO^2+HO^2.

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* Archives de l'Electricité, No. 20, Tome V, 1845.

An interesting fact bearing on this, is the manner in which the mixture of hypo-nitric acid decomposes ferro-cyanide of potassium. If we mix in a tube closed at one end, a solution of the ferro-cyanide with an acid solution prepared as above described, and then invert the tube in water, a violent disengagement of gas takes place, which is found to be pure nitric oxide, and the solution contains nitrate of potassa and the ferricyanide.

This decomposition cannot be attributed to the nitric acid contained in the mixture, for we find that pure nitric acid if slightly diluted, does not decompose the salt, and as neither the hypo-nitric nor nitrous acids can exist in the presence of water.

It is well known that ozone decomposes the iodide of potassium, liberating iodine. If to a solution of the iodide, we add the acid liquor above mentioned, an abundant escape of nitric oxide takes place, while iodine is precipitated and nitrate of potassa forms. Pure nitric when diluted with the same portion of water as in the acid mixture, does not decompose pure iodide of potassium.

The results of Fellenberg are certainly possessed of great interest. The production of nitric acid from the elements of the atmosphere by electricity, was long since noticed by Cavendish, and is a well established fact; but that this acid is formed by the action of phosphorus on air, is a new and highly interesting result. That this highly oxidized body should be generated in the presence of phosphorus, seems at first paradoxical; and we can only refer it to that mysterious force, which Berzelius has named *catalysis*, and which is in fact only a manifestation of the law announced by La Place, that "a molecule set in motion by any power, can impart its own motion to another molecule with which it may be in contact." In other words, the phosphorus, while in the act of oxidation, communicates its own peculiar state to the nitrogen, which is thus enabled to combine with the oxygen and generate nitrous acid. This certainly affords us a very striking illustration of that law, and we think that this phenomenon is incapable of explanation on any other principle. M. Marignac has suggested that electricity generated by the oxydation of the phosphorus may be the cause. This however seems improbable, as it has not been shown that it is excited during the process, and the theory rests on the idea that all chemical action is attended by a development of electricity. But when we consider that our most powerful electrical discharges can generate comparatively very minute quantities of ozone, the amount of electricity that can be supposed, under any circumstances, to be generated by the oxydation of a small piece of phosphorus, seems utterly inadequate to the result.

The experiments of Fellenberg, it will be seen, do not really militate against the existence of ozone; they have only shown that in the ordinary processes by which ozone is generated, nitric acid is also produced, and the similarity between the reactions of air mixed with a little nitric oxide, (by which hypo-nitric acid is generated,) and ozonized air, is readily explained by the researches of Schönbein.

In explanation of the production of nitric acid and ozone by the slow oxydation of phosphorus, we may suppose that nitrous or hypo-nitric acid is generated in the manner before suggested, which, by the action of aqueous vapor in the atmosphere, is converted into nitric acid, and the hypothetical peroxide of azote and hydrogen.

Although ozone produced by chemical means is probably always associated with nitric oxide, yet we cannot avoid the conclusion, apparently overlooked by Schönbein, that the ozone generated under certain circumstances, by the agency of electricity, (as in the experiments of Marignac above mentioned,) must be independent of, and free from nitric oxide. This has the odor and all the other properties of ozone produced by chemical means, and it is difficult to suppose that there can be two compounds, one of which is HO^2 and the other NO^2+HO^2, identical in all their properties, and we are hence led to conclude, that, although such a compound may exist in the mixture of hypo-nitric acid and water, it does not exist in the ozonized air, whether this impregnation is effected by the action of phosphorus, or by agitation with the acid solution in question.

MM. Marignac and de la Rive* have recently obtained some results that seem to prove that water is not essential to the production of ozone. They find that if a series of electrical sparks are passed through oxygen, however carefully dried, ozone is formed, and they suggest that ozone may be nothing more than oxygen, to which "a peculiar state of chemical activity" is given by the influence of the electric current. M. Schönbein, however, regards the formation of ozone as a certain indication of the presence of water in the gas, but in quantities so minute as to escape the action of the ordinary hygrometive substances. The gentlemen above quoted however, find that the oxygen evolved from very pure chlorate of potassa previously fused, gave ozone, when exposed to the action of the electric spark, as abundantly and rapidly as moist oxygen.

M. Schönbein's hypothesis, consequently, rests on the assumption that the gas obtained as above and apparently perfectly dry, still contains water. The suggestion that it is modified oxygen, is one of great interest, and derives some weight from the recently observed facts re-

* Archives de l'Electricité, No. 18. Tome v. 1845.

garding the allotropism of elementary bodies; and particularly the late researches of Draper on the allotropic condition of chlorine.* If oxygen, by the influence of the electric fluid assumes a state of exalted energy and chemical affinity, we are furnished with a key to the *modus operandi* of electricity, in causing many chemical combinations. But in a science which is based on experimental knowledge, we must carefully avoid deducing our conclusions from isolated experiments or theoretical generalizations, however elegant those deductions may appear; and in the case of ozone, very careful investigations, performed with the most rigid exactness, are required before we can admit such a great and interesting conclusion.

At present, then, we agree with Prof. Schönbein, that the great weight of evidence rests with the view that it is a deutoxide of hydrogen, which, although differing from the deutoxide of Thenard, has yet many striking points of resemblance; both bleach powerfully, both transform many protoxides to peroxides, (as, for example, protoxides of calcium and barium,) both transform sulphurous to sulphuric acids, and are decomposed by heat and many organic substances.

With regard to the late results of Marignac and de la Rive, M. Schönbein remarks: 1. Ozone has so strong an odor, that extremely small quantities are capable of affecting the olfactory nerves. 2. Quantities of ozone by far too minute to be ascertained by weight, still perceptibly color the test paste.

From this it follows that a quantity of aqueous vapor, too small to be sensible by our most delicate hygroscopic tests, may generate so much ozone as shall be sensible both to the smell and the iodine test.

We have thus endeavored to give a brief abstract of the present state of our knowledge with regard to this subject, and would refer the reader who wishes to examine the subject more thoroughly, to the authorities already quoted. T. S. Hunt.

2. *Quantitative determination of Urea in Urine;* by W. Hentz, (Pogg. Annalen, No. ix, 1845, and Chem. Gazet., Jan. 1846.)—His method is based upon the fact that urine when mixed with sulphuric acid and heated, has all of its urea decomposed, with the formation of sulphate of ammonia. Take two or three drachms of urine, and heat it with about two drachms of sulphuric acid, until all evolution of carbonic acid ceases, not allowing the temperature to exceed 180°. The liquid is next filtered into a porcelain dish, and most of the water evaporated; then add twenty drops of muriatic acid, and a sufficient quantity of chloride of platinum and alcohol mixed with ether. Allow the mixture to stand for some time; collect the double chloride, and from it estimate the amount of ammonia.

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* See this Journal, vol. xlix. p. 346.

The potash, free ammonia, and uric acid of urine, will interfere slightly with the accuracy of this result, but even this cause of error can be avoided, by first adding to another weighed portion of the urine, some chloride of platinum with three volumes of alcohol and one of ether; which will give the double chloride of the potash and free ammonia contained in the urine, that can be subtracted from what was given by the reaction of sulphuric acid. The error arising from the uric acid is seldom more than $\frac{1}{10000}$; and this acid may be separated from the urine prior to adding the sulphuric acid, by treating the three drachms of urine with thirty drops of muriatic acid, allowing it to stand for twenty-four hours and filtering. J. LAWRENCE SMITH.

3. *Determination of the amount of Ammonia contained in the Atmosphere;* by A. GRAEGER, (Archiv. der Pharm., xliv, p. 35, and Chem. Gazet., Jan. 1846, p. 34.)—The method employed by the author, was to pass the atmosphere through muriatic acid contained in a convenient vessel. After thirty-six cubic feet of air had been made to pass through slowly, the acid liquid was evaporated to dryness in a small platinum crucible placed in a water bath, chloride of platinum being previously added. The residue was treated with alcohol and ether, and the insoluble portion collected and weighed. In the above experiment 0·006 grm. of ammonio-chloride of platinum were obtained, and this was found on calculation to correspond to $\frac{3}{5}$ millionth of carbonate of ammonia in the atmosphere. The experiment has been performed in both dry and wet weather with very nearly the same result. J. L. S.

4. *Test for Ruthenium;* by M. CLAUS, (Chemist, Jan. 1, 1846–7.)—The best means of ascertaining the presence of Ruthenium in the ore of platinum is the following:—Melt it with an excess of nitre in a small platinum spoon, exposing it to a strong heat until the mass no longer swells, but becomes perfectly liquid; then allow it to cool and dissolve it in a small quantity of distilled water. A few drops of nitric acid produce in the orange colored solution, a black precipitate, consisting of ruthenium and potash. If we add hydrochloric acid to the liquid in which the precipitate is found, and heat it in a porcelain capsule, the oxide is dissolved, and by concentration assumes a beautiful orange color. Finally, if we cause sulphuretted hydrogen to pass through the solution until it has become almost black, and then filter it; a liquid of a beautiful sky-blue color will pass through. J. L. S.

5. *Iodine used to distinguish between the Arsenical Antimonial taches formed by Marsh's Apparatus;* by M. LASSAIGNE, (Comptes Rendus, Dec. 1845, p. 1324.)—The taches formed by Marsh's apparatus are exposed to vapor of iodine, when, if they be arsenical, they become of a pale yellowish brown color, which changes to a lemon yellow, and subsequently disappears by exposure to air or to a gentle heat.

The antimonial taches under the same circumstances, become of a carmelite yellow, which, by exposure to the air, passes to an orange and then they remain unchanged.

The alcoholic solution of iodine dissolves instantaneously the arsenical tache. The antimonial tache is not acted upon immediately by the same solution, although as the solution evaporates, the metallic antimonial tache is replaced by one of an orange red, (the ioduret of antimony.) J. L. S.

6. *On the Decomposition and Analysis of the Compounds of Ammonia and Cyanogen;* by R. Smith, (Phil. Mag., March, 1846, p. 222.)—The ammonia compounds are analyzed by liberating all their nitrogen by means of some of the chlorine compounds, and estimating the amount of ammonia by the gaseous nitrogen. The chloride of lime was the salt usually employed for this purpose. This method is regarded by the author as being peculiarly applicable to the analysis of organic substances. He also proposes the employment of chloride of lime as a ready and accurate method of estimating the quantity of nitrogen contained in urine, from the amount of gas disengaged by its action in the nitrogenous compounds.

Hydrocyanic acid and the cyanides are also very rapidly decomposed by the chloride of lime or soda, yielding nitrogen gas and carbonate of lime or soda. The author has also discovered that the hypochlorites decompose uric acid in a very satisfactory manner, and he is inclined to believe that they may be advantageously used as solvents for uric acid calculi in the bladder. J. L. S.

7. *Preparation of the Hypophosphite of Baryta;* by M. Wartz, (Ann. de Chim. et de Phys., Feb. 1846.)—This salt is prepared by boiling a solution of sulphuret of barium with phosphorus, until gas ceases to be evolved. If the ebullition be continued long enough, the whole of the sulphuret will be decomposed; should this not be the case, it is readily got rid of by the addition of a little carbonate of lead, or by the careful addition of sulphuric acid as long as sulphuretted gas is evolved. If an excess of acid be added, it is easily got rid of by a little carbonate of baryta.

All the other hypophosphites are formed from this by double decomposition with the soluble sulphates. J. L. S.

8. *New Acid in Tobacco;* by M. Barral, (Comptes Rendus, Dec. 1845.)—It has been found that the acidity of water in which tobacco leaves have been steeped, is due to a new acid, called by the discoverer *nicotic acid*, composed of C^3HO^3+HO. J. L. S.

9. *Valerianic Acid and a New Substance from Caseine;* by Prof. Liebig, (Annal. der Chem. und Pharm., Jan. 1846.)—Caseine when fused with its own weight of caustic potash, until hydrogen gas is evolv-

ed along with the ammonia, allowed to cool, dissolved in warm water, and super-saturated with acetic acid, furnishes a crystalline substance that is but slightly soluble in cold water and insoluble in alcohol and ether. Its composition is $C^{16}NH^{9}O^{5}$. It is soluble in the alkalies, and combines with acids. If the fused caseine and potash be treated with tartaric instead of acetic acid, and the liquid submitted to distillation, it furnishes valerianic acid. This acid appears to be preceded in its formation by *leucine*, which substance is itself converted in to valerianic acid by the action of potash. J. L. S.

10. *Bromo-boracic Acid*, (*Bromide of Boron;*) by M. Poggiale, (Comptes Rendus, Jan. 1846.)—It is prepared by passing the vapor of bromine through a mixture of charcoal and boracic acid, heated to redness in a porcelain tube. It is well to heat the mixture of charcoal and boracic acid for about half an hour previous to passing the vapor of bromine through it, in order to get rid of any moisture. The acid, which is a gas, can be collected over mercury, this metal absorbing any excess of bromine. It is a colorless gas with a pungent odor and acid taste; it extinguishes combustion and affords white vapors in contact with the air. Chlorine decomposes it with the liberation of bromine. Its density is 8·6443, and its composition is BBr^{3}. J. L. S.

11. *Quantitative estimation of Bromine in Mineral Waters;* by M. Heine, (Journ. für Prakt. Chem., xxxvi, 181, and Chem. Gazet., March, 1846, p. 103.)—A series of liquids containing a known amount of bromine is prepared, by dissolving in every ounce of distilled water from five to fifty milligrammes of bromide of potassium, making a series of ten liquids. Equal quantities of ether, measured in the same glass, are added to these different solutions and the tubes immediately closed. An equal quantity of chlorine water is next added to the solutions and the mixture well shaken. Upon allowing it to rest, the ether collects on the surface, holding in solution the bromine, and we thus obtain a regular scale of colors, from yellow to brown, and these solutions now serve as standards of comparison. Beyond fifty the comparision becomes more uncertain, because the tints of every additional five milligrammes of bromide of potassium can no longer be well distinguished, on account of the dark color. Five milligrammes of bromide of potassium is equal to 3·3 milligrammes of bromide.

As soon as the scale of colors has been prepared, an ounce of the liquid to be examined, is introduced into a vessel similar to the ones containing the test solutions, and to it is added the same amount of chlorine and ether as in the other cases, it is shaken, and the ether allowed to collect upon the surface, the color of which, by comparison with the scale colors, will indicate the amount of bromine present. J. L. S.

12. *Solubility of Sulphate of Lime;* by M. ANTHON, (Chem. Gaz., May 1, p. 173, from Buch. Report, xli, 363.)—M. Anthon digested pure artificially prepared gypsum, at the ordinary temperature, in a close vessel with distilled water, and in another with a saturated solution of common salt. On examination he obtained from 1000 grains of the *first* liquid with chloride of barium, 3·1 grains, and from the *second*, 11·1 grains, sulphate of baryta. In accordance with this, gypsum dissolves in 438 parts pure water, and in 122 parts solution of chloride of sodium.

13. *Analyses of Glass;* by M. PELIGOT, (L'Institut, No. 638, March 28, 1846.)—Bohemian fine glass—silica 76, potash 15, lime 8, alumina 1.

Bohemian agate glass—silica 80·9, potash 17·6, alumina 8, traces of oxyd of iron 0·8, lime 0·7.

Artificial aventurine from the works at Murano and Venice—silica 67·7, lime 8·9, sesquoxide of iron 3·5, oxyd of tin 2·3, metallic copper 3·9, oxyd of lead 1·1, potash, soda 12·6, with traces of alumina, magnesia, and phosphoric or boracic acid. From this analysis it appears that this aventurine differs widely from the glass made in imitation of it by MM. Frémy and Clémandot.*

14. *On the Solubility of Fluoride of Calcium in water, and its Relation to the occurrence of Fluorine in Minerals, and in Recent and Fossil Plants and Animals*; by GEORGE WILSON, M. D., F.R.S.E., (Chem. Gaz. May 1. 1846, p. 183—read before Roy. Soc. Edinb.)—After a preliminary reference to the existence of fluorine in recent and fossil bones, Dr. Wilson stated that he had made a series of experiments with a view to discover what solvent carried fluoride of calcium into the tissues of plants and animals.

His first trials were made with carbonic acid, which was passed in a current through water containing pure fluor-spar in fine powder suspended in it. The fluor-spar was, by this treatment, dissolved, yielding a solution which precipitated oxalate of ammonia, and when evaporated left a residue, which on being treated with sulphuric acid gave off hydrofluoric acid. The author was inclined, in consequence, to suppose that carbonic acid conferred upon water the power of dissolving fluoride of calcium; but on observing that, long after the whole of that gas had been expelled by warming the liquid, the latter remained untroubled, he became satisfied that water alone can dissolve fluoride of calcium, contrary to the universal statement of writers on chemistry.

On prosecuting the inquiry, he found that water at 212° dissolved more of the fluor-spar than water at 60°; but he has not yet ascertained the proportion taken up by that liquid at either temperature.

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* See this Journal, Second Series, i, 430.

The aqueous solution of fluoride of calcium was found to give with salts of baryta a precipitate, which required a large addition of hydrochloric and nitric acid to dissolve it.

The author pointed out the difficulty which must in consequence occur in distinguishing between fluorides and sulphates, and suggested that fluorides may have been mistaken for sulphates in the analysis of mineral waters. He referred also to the objection which must now lie against the present method of determining the quantity of fluorine present in bodies, consisting as it does in converting that element into fluoride of calcium, which, in the course of the necessary analytical operations, is washed freely, and must be seriously diminished in quantity; a fact which has of necessity been hitherto overlooked.

Dr. Wilson stated, that he was not yet able to suggest an unexceptionable quantitative process; but that, at all events, the fluoride of barium, being much less soluble than the fluoride of calcium, might in the meanwhile be substituted for it in the examination of fluoride.

The author then proceeded to state, that, in consequence of the observation he had made as to the solubility of fluoride of calcium in water, he had been led to look for that body in natural waters, and had found it in one of the wells of Edinburgh, viz. in that supplying the brewery of Mr. Campbell, in the Cowgate, behind Minto House. At the same time he stated, that preceding observers had already found it in other waters. He believed however, that he was the first to detect it in sea water, where, by using the *bittern* or mother-liquor of the salt-pans in which water from the Frith of Forth is evaporated, he had found it present in most notable quantity. The author referred to the presence of fluorine in sea water, as adding another link to the chain of observed analogy between that body and chlorine, iodine and bromine.

Dr. Wilson further stated, that he had confirmed the observations of Will as to the presence of fluorine in plants: and Berzelius's discovery, that fluorine exists in the secretion from the kidneys; and had, in addition, detected fluorine in milk and blood, in neither of which has it hitherto been suspected to occur. The paper concluded by some observations on the presence of fluorine in fossils, and its relation to animal life.

15. *Remarkable Discoveries in Isomorphism;* by M. Scheerer, (in a letter to B. Silliman, Jr., from Berzelius, dated March 10, 1846.)—Mr. Scheerer has just found that in compounds containing magnesia, protoxide of iron, oxide of nickel and other oxides isomorphous with magnesia, a part of the base may be wanting without a change of crystalline form, provided that this part be replaced by a quantity of water which contains three times as much oxygen as this part of the base. For example, the compounds $\dot{M}g^{3}\ddot{S}i$, $\dot{M}g^{2}\ddot{S}i+3\dot{H}$, and

$\dot{Mg}\ddot{Si}+6\dot{H}$ in accordance with this principle, are isomorphous. Thus *chrysolite and serpentine may be isomorphous.* The composition of the first, $\dot{Mg}^3\ddot{Si}$, is anhydrous and constant. Serpentine is hydrated and has a varying composition, wherever found, not affording a chemical formula. But examined with reference to M. Scheerer's views, we observe that in all the best analyses of serpentine, the oxygen of the magnesia and of the protoxide of iron, added to *one third* the oxygen of the water, is equal to that of the silica; and consequently serpentine is a variable mixture of two isomorphous silicates, $\dot{Mg}^3\ddot{Si}$, and $\dot{Mg}^2\ddot{Si}+3\dot{H}$. M. Scheerer has brought forward numerous other examples from among silicates, sulphates, &c.

M. Scheerer has also discovered that oxide of copper may be replaced in an isomorphous manner by *two* atoms of water.

We may now see clearly why so many hydrated minerals have never given uniform results, even with the most careful analyses.

The memoir of Scheerer will appear in two or three months, in Poggendorff's Annalen at Berlin. The facts here briefly stated were communicated by him to the Academy of Sciences at Stockholm, at its last session.

16. *Influence of Magnetism on Crystallization;* by R. Hunt, (Phil. Mag., Jan. 1846, p. 1.)—It has been supposed by many writers that electric or magnetic currents must have an influence on the position and character of forming crystals. The experiments of Mr. Hunt illustrate and establish this point in an interesting and satisfactory manner.

A tube containing a concentrated solution of nitrate of silver, was placed against the poles of a permanent horse-shoe magnet, and another tube was set away by itself. Crystallization commenced first in the former, and the crystals started at different angles from the glass where it was in contact with the magnet; none forming above the magnet. In the other tube the crystals had no regular arrangement.

In a second and third experiment, by using for comparison another metal, he shows that the *cooling* influence of the metal was not the cause of this arrangement of the crystals. The crystals, when both poles of the magnet were placed against a capsule containing the same salt in solution, and a piece of metal not magnetic on the opposite side, formed in the fluid almost wholly adjoining the north pole; only three long crystals appeared opposite the south pole, and these were directed towards those springing from the north pole. The same result was obtained in four repetitions of the experiment.

A steel needle was attached, one, to each pole of a suspended magnet, and the two were made to dip into a solution of nitrate of silver in

a watch glass. The crystallizing pellicle on the surface, exhibited curved lines as represented in fig. 1, which lines it is observed are strikingly similar to those assumed by iron filings sprinkled on a paper which is placed over a magnet.

Wires similarly arranged were dipped into sulphate of iron; crystallization commenced around the north pole, and soon after around the south. The position of the crystals showed an obvious tendency to conform to lines of magnetic direction.

When protronitrate of mercury was exposed to the same action, crystallization began at the north pole, and proceeded rapidly to a line half way between the two wires, one half of the fluid being crystallized and the other remaining fluid. At length a few crystals formed around the south pole wire, taking a direction towards those of the north pole.

Fig. 1.

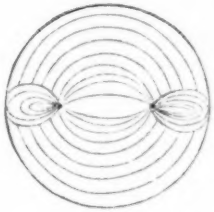


Fig. 2.

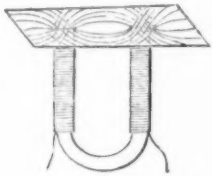
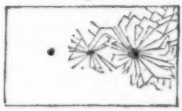


Fig. 3.



Crystallization of nitrate of mercury on a plate of glass over an electro-magnet capable of holding fifty pounds, had the arrangement of lines in figure 2 annexed: and with a small battery of more permanent but less powerful arrangement, the result in figure 3 was obtained.

When a plate of copper was substituted for the glass, and a weak solution of nitrate of silver employed, the curves in figure 4 were produced.

Fig. 4.

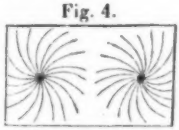


Fig. 5.

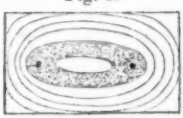
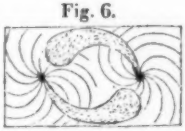


Fig. 6.



A tolerably strong solution of nitrate of silver was put on the copper plate, and this left in contact with the magnet for a night, when the copper was bitten deeply by the acid of the salt of silver, in the oval form in figure 5, the inner part of the oval remaining bright.

Figure 6 illustrates another curious result obtained on a glass plate from a weak solution of nitrate of silver and an equally weak solution of sulphate of iron; in five minutes the silver was precipitated in curves as in figure 4, and shortly two curious curved spaces were formed by

the fine deposit proceeding from one pole towards the opposite, increasing in width and then abruptly ceasing before reaching the other pole.

17. *Faraday's View of Luminiferous Ether;* (Athenæum, No. 965.)—Prof. Faraday, at the meeting of the Royal Institute in April, remarked that the conclusions of Dr. Lyon Playfair, so like his own, and the consideration of the like velocities of light through space and of electricity through dense matter, induced him to utter a speculation long on his mind, and constantly gaining strength: viz., that perhaps those *vibrations* by which radiant agencies, such as light, heat, actinic influence, &c., convey their force through space, are not vibrations of an ether, but *vibrations of the lines of force, which, in his view, equally connect the most distant masses together*, and make the smallest atoms or particles by their properties influential on each other and perceptible to us.

18. *Electrophonic Telegraph.*—The journals of St. Petersburgh speak of an electrophonic telegraph, the invention of the Chevalier Lasckott, which Prof. Jacob has presented to the Imperial Academy of that city. It is composed of a clavier of ten keys, ten bells of different sizes, and ten conducting wires; through whose means the letters of the alphabet and the words which they form are expressed by sounds and harmonies.

II. Mineralogy and Geology.

1. *Ores and Minerals of Lake Superior;* by C. T. Jackson, (Bost. Nat. Hist. Soc. Proceed., March, 1846.)—In connection with many valuable details respecting the mines of Lake Superior, Dr. Jackson states several facts of mineralogical interest. Some of the large masses of pure copper obtained, are stated to be covered with crystals of copper of octahedral and dodecahedral forms. On exploring the chrysocolla deposit at Copper Harbor, a remarkable vein of black oxyd of copper, with black and brown silicates, was discovered. The vein is from eight inches to a foot wide where the black oxyd is obtained, but is very irregular. Dr. Jackson suggests that the chrysocolla, or hydrous silicate of copper, was originally a gelatinous mass, like silica, and that it was deposited on the cooling of the rock; while in the more heated interior the black and brown anhydrous silicates were deposited. He also suggests that the black oxyd might have been precipitated from the hot siliceous solution by the action of hot lime water, which was evidently abundant, and adds that this operation may be easily imitated in the laboratory of the chemist. Trap rocks occur near the vein, and to them the heat is attributed; and the alkalies which produce the analcime in place of laumonite, may have originated from the subjacent igneous rock. Laumonite also occurs in this and in an adjacent calca-

reous spar vein, and is doubtless derived from the lime of the spar and the siliceous and aluminous ingredients of the conglomerate and sandstone. Datholite and prehnite in many of the veins contain points of metallic copper; and this fact is supposed to prove a rapid production of these minerals, instead of slow infiltration, on the ground that if it had been slow, the copper would have been oxydated.

2. *Damourite in the United States;* by E. TESCHEMACHER, (Bost. Nat. Hist. Proceedings, p. 107, March, 1846.)—Damourite, according to Mr. Teschemacher, occurs among the minerals of Chesterfield, Mass., and also with the kyanite of Leiperville, Penn. It is met with as a yellow amorphous incrustation. It gives off water before the blowpipe, becomes milk-white, and melts in the strongest heat at the edges to a white enamel.

3. *Diamonds in North Carolina.*—We have seen a beautiful diamond of fine water, weighing about four grains, taken from a gold washing in Rutherford county, N. C., and understand that others have been found in the same state.

4. *Martinsite, a new Mineral;* by M. KARSTEN, (L'Institut, No. 638, March 25, p. 101.)—The name Martinsite, in honor of Capt. Martin of Halle, has been given to a saline mineral from the salines of Stassfurth, composed essentially of 9·02 parts of sulphate of magnesia, and 90·98 of chloride of sodium. This corresponds to 10 parts by weight of common salt to 1 of sulphate of magnesia.

5. *Transparent Anadalusites from Brazil;* by M. HAIDINGER, (Bull. Soc. Geol. de Franu, 2d ser., i, 20.)—These crystals are green when viewed perpendicular to the faces, and hyacinth-red viewed parallel with the line which unites the longer basal edges.

6. *Diamonds of the Ural;* (Murchison's Russia.)—Mr. Murchison states that he saw upwards of forty specimens of diamonds, in the cabinet of Prince Butera, which were detected in the detritus upon the banks of the Adolfski rivulet, when the alluvium was there worked for gold. The workings for gold having been discontinued in this place, no more diamonds have been found. Baron Humboldt, before his visit to Siberia, had foretold that diamonds would be found in the Ural, as they had in other countries which contain platinum and palladium; while he was there the discovery at Chrestovodsvisgensk was made, and since then they have been found at three other places in the Ural chain. A quartzose micaceous shist, identical with the *itacolumite* of the Brazils, occurs in a portion of the chain adjacent to those mines where the diamonds have been found, as well as in other parts of the Ural. A Brazilian specimen of itacolumite in the Imperial museum of the school of mines contains two diamonds. M. Claussen says that in the province of Mina's Geraes, (Brazil,) powerful and slightly inclined beds of soft

micaceous sandstone having the aspect of itacolumite, repose directly on transition rocks, and contain diamonds between the flakes of mica, just as garnets occur in mica shist.* Mr. Murchison concludes that these precious stones were originally formed in different parts of the world, in secondary deposits not more ancient than those which constitute the flanks of the Ural chain.

7. *Minerals of the Miask;* (Murchison's Russia, 437.)—Mr. Murchison informs us that the rich mineralogical treasures from the Miask region in the Urals, and described by M. G. Rose in his work on the Uralian minerals, are all found either in beds, veins, or nests of the granitic ridge of the Ilmen. Some of these are, zircon, black mica in large plates, green feldspar in enormous crystals, albite, elæolite, sodalite, cancrinite, apatite, ilmenite, pyrochlore, monazite, hornblende, beryl, topaz, garnet, &c. Masses of the rock with which some of the above minerals were associated, and which dip south-west from the sides of the greater Ilmen, and appeared to be nothing more than flag-like stratified granite, forming the external coating of the hill, have, under the critical examination of M. Rose, been distinguished by the new name of "Miascite"—a rock in which in addition to white feldspar and black mica, the place of quartz is taken by elælite. All these rocks are considered as of plutonic origin. On the eastern flank of the Ural-taw, chromate of iron is abundantly found, not less than 20,000 poods† being transported annually to Moscow from one spot, dependent on the Polakofsk Zavod. There, as elsewhere, its associates are serpentine and magnetic iron.

8. *Huge mass of green Malachite;* (Ib.)—At the copper ground of Nijny Tagilsk, at the chief Zavod of the Demidoff family, a mass of green carbonate of copper has lately been disclosed, of unparalleled size. It occurs at a depth of 280 feet, and its base had not been found at the time of Mr. Murchison's visit, only a part of its summit and sides had been cleared from the matrix. The summit alone has a width of about 9 feet and a length of about 18 feet, an enormous botryoidal mass being exposed beneath. The whole of the surface which had been exposed, was calculated to contain upwards of half a million pounds of pure and solid malachite.

9. *Gold and Platina of the Ural and Siberia;* (Mr. Murchison's Russia and the Ural.)—The available deposits of the precious metals in Russia are all of them diluvial sands and coarse gravel, and these are found only on the eastern slope, or Asiatic flank of the Ural mountains, and the comparatively level portions of *eastern* Siberia. The geological

* Bulletin de l'Acad. de Bruxelles, 1841, tome viii, p. 330.

† A pood is about 36 lbs. English.

age of these deposits and of the gold veins is of comparatively recent date and little, if at all anterior to the destruction of the mammoths.

Mr. Murchison concludes that what we now call the Ural mountains, constituted, at the period of the formation of the cupriferous gravel now found on the Permian plains, (west of the Ural,) the rocky shore of a very ancient and probably low continent, from which powerful streams descended into a western sea. From the entire absence of gold in all the deposits there found, and in the earlier "reliquiæ" of this chain, as the carboniferous conglomerates, he infers, with inductive certainty, that this old continent afforded no gold; for had it been so, some trace, however slight, of gold or platinum must have been found in the Permian debris; and yet the long and patient workings of the detrital copper mines on the European side of the chain have never disclosed such a thing. From these and other data, he concludes that the chain became auriferous during the most recent disturbances, by which it was affected, and after the highest peaks were thrown up, when the present water shed was established, and when the syenitic granites and other comparatively recent igneous rocks were erupted along its eastern slopes.

"The only detritus in which grains and portions of gold and platinum have been found, is that in which remains of mammoths and rhinoceroses have also been detected, and coupling this fact with the omission of all auriferous veins in the more ancient alluvia of the chain, there can be no doubt that in this region, gold was one of the most recent mineral productions anterior to the historic era." "We believe, then, that before the surface assumed its present outline, the tract we now call the Ural mountains was a low ridge, extending from north to south, and forming the western shore of a continent on which such animals lived and died during long ages." (475.)

The gold detritus of the Ural is not the residue of rivers and streamlets, but is a coarse gravel and shingle, composed chiefly of moderately sized and small subangular fragments of the adjacent rocks. The sides of the Ural are devoid of those great transported, and rounded blocks, which cover the Scandinavian and other chains; every loose fragment having been derived from an adjacent elevation, and washed down in strict relation to the chief existing features of the land. The term *drift* cannot be correctly applied to the Uralian masses, which are purely *local;* neither do the sides of the mountains exhibit striæ of denudation, nor polished surfaces.

The gold mines of Ekaterinburg are interesting as offering the only subterranean shafts in all this region, by which gold is still extracted from the parent rock. The mines have furnished from 1745 to 1841, 52,000,000 poods of ore stuff, (about 940,000 tons of 2,000 lbs.) and

this had yielded 679 poods of gold, or about 2,445 lbs. The gold here occurs in quartz veins, which are contained in parallel bands of a felspathic rock, called "beresite," which Rose considers as a decomposed granite, trending from north to south. The chief fundamental rocks are talcose and chloritic schists and clay slates, and through these the "beresite" cuts. The shafts, none of which are lower than 25 fathoms, are sunk vertically, and lateral galleries are made in the masses of "beresite," which in contact with the quartz veins is usually compact and hard, but at a little distance from them it resembles kaolin or decomposed feldspar rock. Between the beds and the "beresite," the talcose rock is changed into a reddish and decomposing altered rock, called "*crassick*" by the workmen.

The auriferous alluvium invariably overlies the auriferous rocks, "beresite," and other granitic rocks, clay slate, and loose limestone, which are often of great extent, but so poor in gold as not to pay for working, all the productive mines being in the alluvium. The alluvium is notably rich along the zone, where greenstones, porphyries and serpentines have traversed ancient limestones, and is most productive in those spots where the broken materials and coarse sands are most ferruginous. During the progress of washing, the black glancing grains of magnetic iron ore form a good indication of the presence of gold. The annexed diagram will show the relations here explained.

The auriferous rocks are seen *in situ* at (*a.*) The auriferous detritus immediately over them (*b*,) covered by the overlying clay (*c*,) capped by humus and bog. The small stream called the Berezof (*d*,) cuts through this gravel, and by its aid the workings are accomplished. The bones of mammoths and other extinct quadrupeds are also found in these auriferous gravel beds.

The mine of Peshanka, near Bogoslofsk, is in a sandy gravel, containing no fragments of quartz veins, and it is supposed that the gold was here also uniformly diffused in the subjacent syenitic rock, which is said to yield gold on analysis. From 1829, when it was discovered, to 1840, or in eleven years, this mine yielded 256 poods, or 10,000 Russian pounds of gold.* The gold alluvium is always a coarse local detritus, varying from 2 to 10 or 12 feet in thickness, and usually covered with much stiff clay. The stony fragments of course vary in every locality with the nature of the adjacent rocks, but quartz

* The Russian pound is 14 oz. 7 dr. English.

abounds in nearly all. In one set of works, fragments of "beresite" prevail, in another greenstone porphyry, in a third serpentine, in a fourth augite porphyry. Iron pyrites appears in one and not in another; but garnets, zircons, magnetic iron ore, chromate of iron, specular and other ores of iron are with rare exceptions common to all these accumulations. The gold mines south of Miask, are among the most productive of the Russian mines, in the undulating grounds on the western side of the Miask. This rich detritus has been carried by the diluvial current quite to the summit of some of the greenstone hills. In the depressions the greatest masses of detritus have accumulated, and are there covered with a thick spread of clay. In these hollows, particularly around the Zavod of Zarevo Alexandrofsk, the very heavy pepites or lumps of solid gold have been found. These masses have weighed respectively 13, 14 and 24 pounds, but since Mr. Murchison's visit, the huge lump weighing 78 English pounds has been found; all of these are in the Imperial museum at St. Petersburg. As a general thing, however, large lumps of gold are an exception in the Ural.

Platinum, in the Urals, is now worked only within the territories of the Demidoff family. Mr. Rose found gold in only one of the numerous platinum deposits which he examined, and in no instance could he detect any vein-stones of quartz or other fragments of rocks, or of magnetic iron, so abundant in the gold alluvia. It has been found in grains weighing from 14 oz. to 1 lb. and rarely 2 and 3, and in one instance 8 lbs. It is found in much smaller accumulations than the gold, but like the gold, it has been lately shown by M. Schwetzof and M. Le Play, that it is disseminated throughout the entire mass of certain crystalline rocks. He has traced up more than 20 courses of platiniferous alluvium to the common centre, the Mount La Martiane, from which they have been all derived, and of whose detritus they are all composed. This cannot, however, be taken as a general fact of the origin of this metal.

10. *Axinite and other Minerals in a Fossiliferous rock;* by M. A. Daubrée, (Bull. Soc. Geol., 2d. ser., i, 408.)—Axinite has been detected in the Vosges in a fossiliferous rock, which had been altered by contact with a variety of trap. The rock had been rendered hard siliceous, and had lost its fissile character. It contains numerous impressions of Calamopora spongites (Goldfuss,) and Flustras; and in these same parts, there are nodules of lamellar calcite, and also some epidote, hornblende and quartz. It appears that the lime of these nodules was derived from corals, and the same contributed to the formation of the epidote and hornblende. Moreover, the crystallization of these minerals took place without a softening of the rock. In some cavities there are crystals of these minerals with others of Axinite.

11. *Fluoride of Calcium in Cannel Coal*; by H. D. Rogers, (Proceed. Bost. Nat. Hist. Soc. p. 109, March, 1846.)—Prof. Rogers remarks that the English Cannel coal, which he had been using in his grate, often dispersed over his apartment, with a violent crepitation, small fragments of fluor spar. Some of the fragments were more than half an inch in diameter. Afterwards, upon breaking a piece of the coal, he detected a small isolated crystal of this mineral. Prof. Rogers suggests that the elements of this mineral may have been derived from the coal vegetation; adding also, that it is possibly due to volcanic agency below, setting at liberty vapors of hydrofluoric acid.

12. *Petrified Wood in Texas;* by J. Limber, (in a letter dated, Independence, Texas, April 24, 1846.)—In this region, and especially north of this, pieces of wood, petrified, are found in great quantities. In some localities, stumps of trees three feet through, pieces of trunks of trees of the same size, and from two or three to twenty feet long, cover the whole face of the ground. Magnificent specimens might be obtained for cabinets. Should any institution wish a specimen, and will write to me, I will take a pleasure in procuring for them, specimens of such size as they will specify. The expense of transportation would not be great, as they could be taken down the Brassos to the Gulf of Mexico, and thence to any part of the United States by water.

13. *Falkland Islands;* by C. Darwin, (Athenæum, No. 965.)—The low lands of the Falkland Islands consist of clay slate, containing subordinate layers of sandstone, and the slate occasionally, though rarely, and the sandstone more commonly, give indication of fossils, which prove the existence of palæozoic rocks in these southern regions. The exact position among palæozoic strata is not determined. The slaty and fossiliferous beds of these islands are broken by numerous east and west ranges of stratified quartz, attaining sometimes a height of 2,500 feet.

14. *Tertiary of Warren Co., Mississippi;* by T. A. Conrad. (Communicated for this Journal.)—While collecting the organic remains of Warren county, Mississippi, I noticed a few shells which appeared to be identical with species from Claiborne, Alabama, but since I have carefully compared them in my cabinet, they prove to be distinct; and it is very remarkable that of the one hundred and three species of fossils found near Vicksburg, not one can be identified with a species of the Eocene of Maryland, Virginia, or Alabama. There is a species of Trochus resembling T. agglutinans; but the specimen is too imperfect to decide whether it agrees with the fossil T. agglutinans of Georgia. The Vicksburg group has decidedly more affinity with the Eocene group than with that of the Miocene, for there is only one species that closely resembles a Miocene fossil. The limestone of Clarke

county, Ala., and of St. Stephens on the Tombeckbee, contains Nummulites crustaloides and Pecten Poulsoni, (Morton,) two fossils which abound in the Vicksburg deposits, and this limestone is therefore probably of the same age as the tertiary beds of Vicksburg. This formation marks a distinct era in the American tertiary system, intermediate to the Eocene and Miocene formations, but more nearly allied to the former, and perhaps it will be proper to class it as a subdivision of the Eocene. The following table will explain these subdivisions.

Miocene,	Maryland, Virginia, &c.	About 50 recent species.
Upper or newer Eocene,	Natchez, Vicksburg, &c.	103 extinct species; no recent species; and all distinct from those of the lower division.
Lower or older Eocene,	Piscataway, and Fort Washington, Maryland, Claiborne, Alabama, &c.	200 extinct species.

The following genera of shells occur at Vicksburg.

Univalves.	No. of species.	*Univalves.*	No. of species.	*Bivalves.*	No. of species.	*Bivalves.*	No of species.
Actæon,	1	Oliva,	2	Astarte,	1	Mytilus,	1
Buccinum,	2	Pyrula,	2	Amphidesma,	1	Nucula,	3
Bulla,	1	Purpura,	1	Avicula,	1	Ostrea,	1
Cypræa,	2	Pleurotoma,	7	Arca,	1	Panopea,	1
Cancellaria,	1	Rostellaria,	1	Cardium,	4	Pecten,	1
Carsis,	6	Solarium,	2	Chama,	1	Pectunculus,	1
Dentalium,	1	Scalaria,	1	Crassatella,	1	Pinna,	1
Fusus,	2	Sigaretus,	2	Cytherea,	4	Sanguinolaria,	1
New Genus,	1	Turbinella,	2	Corbula,	3	Tellina,	3
Mitra,	6	Triton,	3	Capsa,	2	Venus,	2
Murex,	1	Terebra,	1	Lucina,	1	*Multivalves.*	
Natica,	3	Typhis.	1	Loripes,	1	Pholas,	1
Nummulites,	1	Turritella,	2	Lima,	1	Balanus,	1

A few of these fossil shells have a striking resemblance to species from Dax, Grignon and Bordeaux, and I believe that the Vicksburg tertiary will prove to have been deposited in an era more nearly allied in age to that of the localities mentioned above, than to the Eocene of Paris or London.

III. Zoology.

1. *On the Zeuglodon Remains of Alabama;* by S. B. Buckley. (Communicated.)—Since it has been conclusively proved that the bones of the Zeuglodon, which Mr. Koch exhibited in New York and elsewhere, under the name of Hydrarchos, belonged to different individuals, some may be disposed to doubt that the skeleton of the Zeuglodon, which I obtained in Alabama, now in possession of Prof. Emmons, at Albany, N. Y., is of one individual animal. On this point I would make the following statements.

Through the assistance of Judge Creagh, of Clark Co., Alabama, at a locality nearly three miles from his house, (I think southeast) I obtained a vertebral column fifty feet in length, commencing near the tail and extending towards the head. Judge Creagh had commenced digging at the same place about three years before and found some twenty or twenty-five feet in length of the vertebral column. These vertebræ at the locality extended in a line in their natural order, but owing to their exposed situation the processes were mostly broken off. After considerable search we struck the remaining portion of the vertebræ, at a depth of about two feet, and traced them to a depth of six feet, extending into a side hill. Up to this point the vertebræ lay in close connection, joining end to end, but here their connection was broken off, and owing to the difficulty of digging we ceased work, despairing of obtaining the remainder, which could probably have been secured at the expense of much time and labor. The tail of this individual lay imbedded in a rich bottom composed of black vegetable mould, and its head, without doubt, lay beneath the adjoining hill. The black soil was about eighteen inches deep; beneath this was a yellowish white marl to the depth of six feet, below which was a hard green sand marl in which the last bones we obtained at this locality were imbedded. These bones were numbered, and left in Judge Creagh's door-yard at his request, for the state collection of Alabama; as to their fate since, I have not been informed.

After a few months I returned to Judge Creagh's in 1842, who informed me that a few years before, he had got a few bones to send to Harlan, at Philadelphia, at a locality about three miles distant, and not far from the place where we obtained those already mentioned. We went there chiefly to obtain a head or parts of one; and at a depth of from one to three feet, we dug out a vertebral column commencing near the lumbar region and extending towards the head, measuring twenty six feet in length. The vertebræ were often displaced, sometimes one, two and three feet intervening between them, among which were scattered ribs which were *in situ*, and were generally broken in the middle, the two opposite ends approaching each other. By carefully removing the earth from the upper surface of several of these, we found their length from measurement taken on the spot, to be from four to six feet. At the time we were digging, the ground was very wet from recent rains, and the ribs were so brittle that we succeeded in getting only a few fragments, not more than two or three of which are now with the skeleton at Albany. The vertebræ at this locality were large and in an excellent state of preservation, better than those I found at any other locality, and I now regret that I did not bring any of them away, since they were all left on the ground. While I was engaged here

with one of Judge C.'s negroes, a servant came with the following letter from Judge C., the original of which is now in my possession.

"*Dear Sir*—Most fortunately and apropos, this morning a negro fellow discovered twenty-five feet of a Basilosaurus, with the head, &c., in a line exposed upon the surface of the earth. From appearances, the balance can easily be obtained. I send a boy with a horse for you, supposing it best for you to return to the bones and commence operations here. The place is about half a mile from the house.

Yours respectfully, J. G. CREAGH."

On the receipt of this I repaired to the spot, where I saw for the first time parts of a head and teeth of the Zeuglodon. The Judge had not suffered any of the vertebræ to be disturbed, merely having caused a thin layer of earth to be removed, so as to expose twenty five feet of the animal. A negro that morning had discovered them with his plough, while ploughing, lying in a gentle slope of land, whose surface had been much carried away by the late rains. The field had been in cultivation during many years. Here we obtained the skeleton, which is now at Albany, of which I gave a short account in this Journal in the spring of 1843, and I now repeat what I then published, that it evidently and undoubtedly belonged to one individual animal; excepting the vertebræ of the neck, which were partly displaced, (but lay on a surface less than a rod square, and those that were displaced lay near the head or rather its fragments,) the vertebræ were in an almost unbroken series to the extreme tail—most of them were connected and sometimes two or three would stick together when pryed out of their bed, their ends generally joined; nor do I think there was more than once a vacancy of six inches. The vertebræ increased in size from the neck downward, attaining their maximum size in the lumbar region, at which point our skeleton attained a length of sixty feet or more, and we were much disappointed when it tapered off soon to the tail, at a length of nearly seventy feet. The general outline of the skeleton greatly resembles that of the Plesiosaurus, and this lead Judge Creagh and myself at the time in our discussions with regard to the nature of the animal, to say that Owen must be wrong in referring it to the Cetacea.

These bones constitute by far the most perfect skeleton of the Zeuglodon known, and they are now in possession of Prof. Emmons, at Albany, N. Y. The vertebræ are numbered in the order in which they were obtained.* The boxes in which the bones were brought from

* Our skeleton has the anterior terminal portions of both jaws, with teeth, base of lower jaw, a perfect femur, a portion of a scapula, with the heads of the humerus, an entire humerus, a distinct portion of a fore arm, radius and ulna, a portion of a pelvis, with many fragments of ribs from one to three feet long, besides the vertebræ already named.

Alabama contained a few portions belonging to other individuals, among which are one or two vertebræ which were not numbered, and which were never intended to be palmed off as belonging to the skeleton. Also a few fragments of ribs already mentioned, and the tibia (?) figured by Prof. Emmons, and described in the American Quarterly Journal of Agriculture and Science, vol. iii, p. 227. This specimen belongs to the first individual described in this note. However, no one would suppose but that it belonged to the skeleton at Albany, since the vertebral columns of the two individuals were nearly of the same size. The base of the lower jaw, plate 1, fig. 1., described by Dr. Emmons, p. 228 of the same volume, was obtained near the summit of the hard grey limestone bluff, about a mile from Suggsville, Clark Co., and about twenty-five miles distant from the Creagh plantation. This bone was imbedded upon the upper surface of the rock, and the outer surface of the bone was exposed and showed the yoked teeth with their large serratures in great perfection. It was upwards of three feet long. Owing to the hardness of the rock and brittleness of the bone, the specimen was often broken before detaching it with a large portion of rock, at the close of a toilsome day's work. I obtained this specimen through the kindness of Dr. Denny, of Suggsville, who informed me of its existence. It is proper to add that the skeleton at Albany has its own portions of the lower jaw, so that Prof. Emmons knew that it belonged to a different individual, and has merely described it as an interesting bone of the collection.

I should have stated that before going to Suggsville I visited another locality about a mile from Clarksville, on the road towards Macon, in Clark Co. This skeleton was in a sandy loam, and the bones were in a bad state of preservation, doubtless caused by the predominance of sand and deficiency of lime in the soil. I only staid there part of a day, having met with several thin plates of bone belonging to the jaws, several cervical vertebræ and fragments of ribs. The vertebræ and ribs were larger than those of the skeleton at Albany, and were all left on the spot excepting two fragments of ribs eight or ten inches long, which are with the skeleton at Albany. My object in visiting this locality was to obtain something approximating to a perfect head, and as soon as I saw it could not be done, the locality was abandoned. I believe that a larger vertebral column than any yet obtained is still there. I saw a single vertebra of the zeuglodon, in possession of Mr. Cooper, a lawyer at Claiborne, which was eighteen inches long, and twelve inches in diameter at the ends.

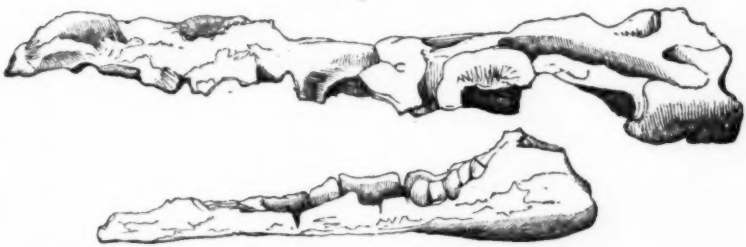
From what I have written it will be seen that the bones which I have enumerated as not belonging to the individual skeleton in Albany, add not to its size, nor were they ever intended by me to be considered as

part of that skeleton; but only more fully to illustrate the nature of the remarkable animal to which they belonged. I will add, that Judge Creagh informed me that the bones which he sent to Harlan, were found in different and distant places on his plantation, but described by Harlan as from one locality and belonging to one individual. The fragments of a jaw-bone, containing teeth much broken, were found about three-fourths of a mile from the house. This was the specimen which Harlan took to London, and from which Owen named the animal.

Judge Creagh was among the first settlers of Alabama, and he often told me of the large number of bones which were on his and the adjoining plantations, when he first moved there, how they interfered with the tillage of the soil, and how vast numbers of them had been burned and otherwise destroyed; and he added that an old hunter who lived among the Indians prior to the settlement of that country by the whites, had often told him that he had seen several entire skeletons of this animal, lying upon the surface of the ground, upwards of a hundred feet in length.

Zeuglodon Cetoides.—In addition to the foregoing remarks of Mr. Buckley, we take this opportunity of presenting an outline sketch of the head and one of the teeth of this animal, which were drawn for us by Mr. Russell Smith of Philadelphia, from the skeleton which has been fancifully called the *Hydrarchos*, by Koch. The head, as measured by Dr. Wyman,* is five feet seven inches long. "That part purporting

Fig. 1.



to be the cranium proper, and which serves more especially to protect the brain, consists apparently of a single bone and is destitute of any visible sutures, is a little more than one foot long, about five inches wide, and has, attached laterally by cement, two bones forming incomplete zygomatic arches. Inferiorly it is so much covered with cement, that little or nothing can be seen of its surface. Posteriorly there are no condyles, nor any foramen for the passage of the spinal marrow; in fact no foramina are any where visible. These characters lead to the

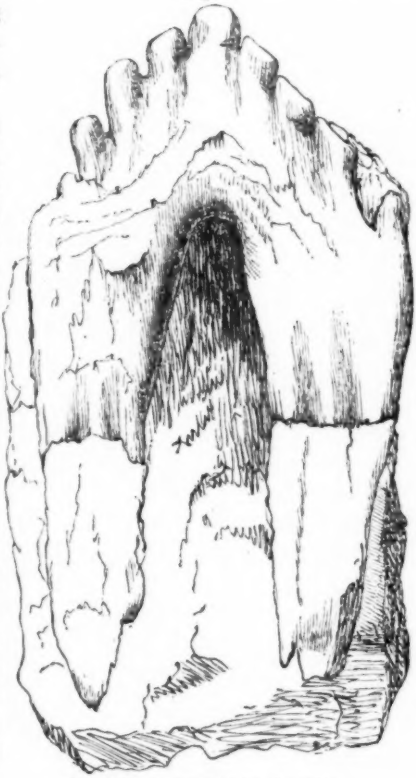
* Proceedings of the Boston Soc. of Nat. Hist., Nov. 1845, p. 65.

supposition that it is not the true cranium, but that it may be some bone or fragment not in its natural position. The size of the supposed cranium is obviously too small for lodging the brain of an animal 114 feet long, inasmuch as its cavity, if it had one, can exceed but little that of the spinal canal, which is visible in some of the vertebræ." "The jaw has been crushed by violence," and the fragments, sometimes inverted, are held together by the natural matrix, in which the whole was originally imbedded.

Two of the cochleæ of the ear of the Zeuglodon, were detected by Prof. H. D. Rogers,* among the loose bones of Koch's collection. They are about the size of a small lemon, and display that variety of the whorled or convoluted form of the cochlea, peculiar to the Cetacea.

The teeth of this animal vary much in size and form, as may be seen by comparing the annexed figure with those lately published by Dr. Emmons,† from the skeleton brought to Albany by Mr. Buckley, and also with those published by Dr. R. W. Gibbes‡ of South Carolina, under the name of *Dorudon serratus*. The figure here given shows very perfectly the *yoked* form of the teeth, from which Prof. Owen has derived the name Zeuglodon. It is one third less than the natural size. No perfect series of the teeth of this animal has yet been seen by a good anatomist, "and we are therefore ignorant what are the varieties of form which such a series would present,

Fig. 2.



Two-thirds natural size, lineally.

* Proceedings of the Boston Soc. of Nat. Hist., Nov, 1845, p. 79.
† Am. Quarterly Journal of Agriculture and Science, vol. iii, p. 228.
‡ Proceedings of the Acad. of Nat. Sci. of Philadelphia, June 1845, p. 254.

in different parts of the same jaw." It is interesting to know that the geographical range of this animal has been carried so far east as the Santee canal in South Carolina, from whence the teeth and portions of the jaw, figured by Prof. Gibbes, were taken, being imbeded in the green sand marl.

With regard to the skeleton exhibited by Mr. Koch as the Hydrarchos, Dr. Wyman concludes, 1st, that these remains have never belonged to one and the same individual; 2d, that the anatomical character of the teeth indicates that they are not those of a reptile, but of a warm-blooded mammal. It is worth mentioning, as an instance of the accuracy and skill of the joiner of the Hydrarchos, that the extremities of the so called paddles of this skeleton, were formed of "*casts of a camerated shell, a species of nautilus*"! of which, specimens, brought from the state of Alabama, and now in the cabinet of the Academy of Natural Sciences, were shown to Prof. Wyman, by Dr. Morton of Philadelphia.*

2. *Mastodon Giganteus.*—The publication of Prof. Owen's "British Fossil Mammalia and Birds," has supplied us with the means of presenting our readers with a most perfect and elaborate portrait of the fine specimen of this animal, which is now standing in the British Museum. Mr. Owen says, (p. 298,) "The almost complete skeleton of the *Mastodon giganteus*, so well known to the public as the "*Missouri Leviathan*," when exhibited, with a most grotesquely distorted and exaggerated collection of the bones in 1842 and 1843 in the Egyptian Hall, Piccadilly, but now mounted in strict accordance with its natural proportions, in the British Museum, has enabled me to present, in the subjoined cut, (see next page,) as perfect a representation of the mastodon, as that of the mammoth given at the head of the preceding section."†

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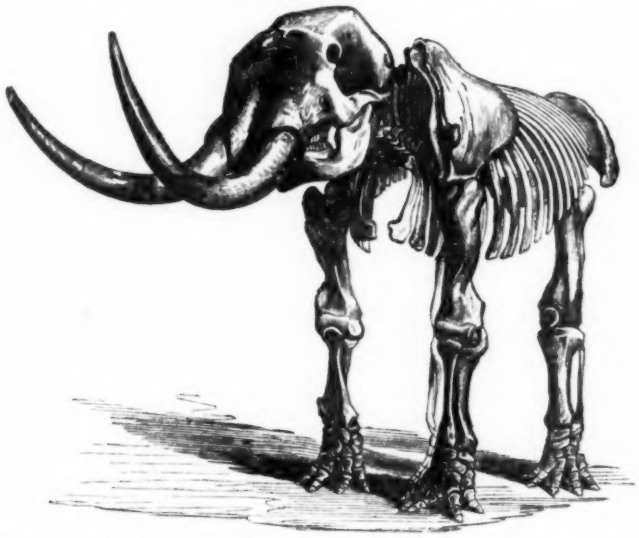
*Having received more than one application from respectable persons, unacquainted with comparative anatomy, to express an opinion as to the character of Koch's Hydrarchos, we will only say, that if the foregoing remarks, the testimony of one of the best comparative anatomists in America; the evidence of Mr. Lyell and Mr. Houston, (vol. i, p. 313) and of Dr. Lister; (Proceedings Bost. Soc. Nat. Hist. Feb. 26, p. 94) are not sufficient to convince the most credulous of the fictitious character of this skeleton, perhaps their faith in the skill of the joiner may be enlightened by a perusal of the following note on the mastodon. It is certainly not impossible that a Zeuglodon may be found 114 feet long; but if constructed by the same inventor, we might as well expect to see it 300 feet in length.

† Those who saw the "grotesquely distorted" monster, which was shown by Mr. Koch in this country, as the Missourium or Leviathan, will hardly recognize in the beautiful drawing on the next page, the same animal as restored by the accurate hand of Owen. The large lithographic print of the animal as mounted by Koch, which this person had executed at Dresden, will serve to convey to

In spite of much quackery and pretence, not only on the part of the notorious "author of the two largest known animals," (i. e. the "Missourium" here figured, and the *Hydrarchos*,) but also, from those, whose position and opportunities should have produced better things,* we have at length settled quietly down upon the true and well ascertained characters of the great American mastodon. Dr. J. B. S. Jackson has given us a lucid statement of the principal osteological characters of the mastodon.† His observations were made on the skeleton found at Schooley's Mountain in New Jersey in 1844, which was however deficient in the sternum, a few caudal vertebræ and the feet.



He determined from this skeleton, that the animal had twenty dorsal vertebræ, whereas Cuvier and Owen make but nineteen; this observation is confirmed by the skeleton found at Newburgh‡ last summer, (1845,)

those who did not see this "anatomical fiction," a good idea of its awful proportions. It will be remembered as one characteristic of the genus "*Missourium*," that the tusks were placed at ninety degrees from their true position, pointing *outward* and backward. The trustees of the British Museum paid the owner, £1000 sterling (not "£2000") for this skeleton, and £300 additional for some accompanying bones. This we know from the very best authority.

* Proceedings of the Geol. Soc., June 15, 1842.

† Proceedings of the Boston Soc. Nat. Hist., Oct. 1, 1845, p. 60.

‡ American Journal of Science, Second Series, i, 269. See also a letter of Dr. Warren's to Mr. Owen, published in the Ann. Mag. of Nat. Hist., for March, 1846, No. iii, p. 145, in which he says the vertebral column has "7 cervical vertebræ, 20 dorsal, 3 lumbar, and the os sacrum." The ribs, 20 in number, are perfect.

and now in the possession of Dr. Warren.* Cuvier had suggested that one vertebral bone might be wanting, (*Ossemens Fossiles,*) and then that the number would be the same as in the elephant. The dentition of the animal has been satisfactorily made out by Mr. Owen, who finds *seven* teeth belonging to the series of the lower jaw, counting from the youngest.

It may seem unnecessary to state that the genus *Tetracaulodon* of Godman†, was clearly shown by Mr. Owen,‡ in 1842, to be only the immature state of both sexes of the *Mastodon giganteus* of Cuvier, and that in the male, one, at least, and usually the right, of the two lower tusks was retained, but that in the female both were lost as she approached maturity.

IV. Botany.

1. *Vegetable Physiology.*—M. Dutrochet in connection with M. Becquerel has shown that when a Chara is subjected to the action of an electric current, the peculiar circulation of this plant ceases for a while, and is recontinued after a certain period, if the current is unchanged; it is discontinued in the same manner with each change in the intensity of the current, whether the intensity is increased or diminished.

Variations of the temperature produce nearly the same effect, and it is also apparent on transferring the plant from fresh to salt water, and the reverse.

Electro-magnetism causes no effect. The circulation is not at all influenced by an electro-magnet capable of supporting near 2000 kilogrammes, whether at the establishment or breaking of the current, the reversing of the poles, or any other mode of operation.

M. Dutrochet concludes from these facts that the circulation in the Chara depends on a peculiar *vital force*, and not at all on electricity or magnetism, as the first of these, acts like all other exciting forces, and the second not at all.

2. *Distribution of the Vestiges of Palms in the Geological formations.*—Prof. Unger, in the work here cited, states, 1st, that no vestiges of palms have been detected in the earliest rocks which contain the organic remains of maritime and terrestrial plants. 2d. That palms bore some small part in the vegetation at the period of the coal formation, in which Ferns, Lycopodiaceæ, Lepidodendreæ, Calamiteæ, Cycadaceæ, and Coniferæ appear to have formed the principal growth. He names the following forms, viz.:—

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* See also the Am. Quarterly Journal of Agriculture and Science, vol. ii, p. 203.

† Transactions of the Am. Phil. Soc., New Series, iii, 478.

‡ Proceedings of the Geol. Soc., 1842.

Flabellaria borassifolia, *Sternb.* Coal schist, Swina, Bohemia.

Palæospathe Sternbergii, *Unger.* Ibid.

P. aroidea, *Unger.* Sandstone, Ural Mountains.

Zeugophyllites calamoides, *Brongn.* Rajemahl, North India.

Two undescribed species of Gœppert, from the coal formation of Silesia.*

3d. The flora of the red sandstone, although it has been very imperfectly preserved, and its scanty remains but little studied, Unger thinks was not materially different in type from that of the coal formation. But the fossils of this era which have been referred to palms, he thinks are very doubtful. Even in the variegated sandstone, which furnishes the remains of some other Monocotyledonous plants, no palms are found; nor are there any traces of them quite up to the *quadersandstein*, in which Gœppert found some vestiges in Silesia, (Flabellaria chamœropifolia.) From an older formation, the Oolite, the four species of Carpolithes described by Lindley and Hutton, may be mentioned.

4th. Finally in the tertiary, palms reappear, and the number of species far surpasses that of all the other formations together. In the eocene formation, there are,

Flabellaria parisiensis, *Brongn.*, from the chalk, near Versailles.

Palmacites echinatus, *Brongn.* Lower chalk strata, near Soissons.

Burtinia Faujasii, *Endl.* Lieblar, near Cologne.

B. cocoides, *Endl.* Woluwe, near Brussels.

The fruits called Nipadites by Bowerbank, belong to the same formation. In the miocene formation, we have—

Flabellaria Latania, *Rossm.;* "in arenaceo lignitum," at Altsattel, Bohemia.

F. raphifolia, *Sternb.;* in bituminous calcareous schist, at Häring, in Tyrol, Lausanne, Switzerland, and Piancourt, near Amiens.

F. oxyrhachis, *Ung.* Häring, Tyrol.

F. verrucosa, *Ung.* Ibid.

F. ? crassipes, *Ung.* Ibid.

F. Martii, *Ung.* Ibid.

F. major, *Ung.* Häring, Tyrol.

F. Hœringiana, *Ung.* Ibid.

F. maxima, *Ung.* In argillaceo-calcareous schist, at Radab, Croatia.

F. Lamanonis, *Brongn.* Gypsum schist. Provence.

Phœnicites pumila, *Brongn.*, among lignites, at Chartreuse, Puy en Velay.

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* As respects palm fossils of this age, see Brongniart, in Comptes Rendus, Dec. 1845, and in Ann. and Mag. Nat. Hist., Feb. 1846.

P. spectabilis, *Ung.* Calcareo-argillaceous schist, Radab.
P. salicifolius, *Ung.*, "in arenaceo lignitum," Altsattel.
P. angustifolius, *Ung.* Ibid.
Fasciculites didymosolen, *Cottæ*, *Ung.* Litmitz, Bohemia.
F. Cottæ, *Ung.* Locality unknown.
F. anomalus, *Ung.* do.
F.? lacunosus, *Ung.* do.
F. palmacites, *Cottæ.* Tertiary at Chemnitz? Antigua?
F. perfossus, *Ung.* Altsattel, Bohemia.
F. Partschii, *Ung.* Locality unknown.
F. Fladungii, *Ung.* do.
F. sardus, *Ung.* Bonarvo, Sardinia.
Baccites cacoides, *Zenk.* Altenburg, Saxony.
B. rugosus, *Zenk.* Ibid.
Endogenites. Brongn. Prodr. p. 208. Horgen, near Zurich.

In the pliocene formation, there are—

Flabellaria antiguensis, *Ung.* Island of Antigua.
Palmacites crassipes, *Ung.* Ibid.
Fasciculites antiguensis, *Ung.* Ibid.
" Withami, *Ung.* Ibid. A. Gr.

3. *Analogy between the Flora of Japan and that of the United States.*—Prof. Zuccarini, the author, in conjunction with Dr. Siebold, of the excellent *Flora Japonica* now in progress, (which we have more than once noticed in this Journal,) has recently published the first part of a brief memoir, entitled, "*Floræ Japonicæ familiæ Naturales, adjectis generum et specierum exemplis selectis:* Sect. 1, *Plantæ dicotyledoneæ polypetalæ.*" It is interesting to remark how many of our characteristic genera are reproduced in Japan, not to speak of striking analagous forms. Thus the flora of Japan has not only Wistaria, Lespedeza, Sieversia, Chimonanthus (in place of our Calycanthus), Philadelphus, several species of Rhus closely resembling our own, and two peculiar genera of Juglandeæ, but also a Pachysandra, some Berchemias, a Staphylea, and a peculiar genus of the tribe (Euscaphis), besides, not only a dozen Maples but also a Negundo, a Stuartia, two Tilias, a Phytolacca, an Opuntia (surely not indigenous?), a Sicyos referred to our own S. angulata, two Droseras, a Nelumbium, a Nuphar and two species of Nymphea, Gynandropsis, a real Dicentra (Dielytra) and an allied new genus, with several species of Corydalis, a Trollius, our own Coptis and two new ones like the western C. asplenifolia, an Isopyrum, two species of Aquilegia, one of them near A. canadensis, a Cimicifuga, a Trautvetteria, an Illicium, some Magnolias, Kadsura and Sphærostemma in place of Schizandra, a Mitellopsis, two species of Astilbe (Hoteia), many Hydrangeas as well as peculiar

Hydrangeaceous forms, a Hamamelis with two other characteristic genera of the family, some true Dogwoods, as well as Benthamia the analogue of our Cornus florida, some true Vines, and two species of Ampelopsis, three species of Panax, and four of Aralia, one of which is near our A. nudicaulis: and among Umbelliferæ are Hydrocotyle, Sanicula, Sium, Angelica, but what is most remarkable, Cryptotænia, Archemora, and Osmorhiza! Further cases of generic conformity abound in the remaining divisions of the vegetable kingdom; thus, for example, Diervilla, Mitchella, Maclura, Liquidambar, Torreya, and Sassafras! are represented in the flora of Japan. A. Gr.

4. *Conspectus of the Fossil Flora.*—Prof. Unger, in his *Synopsis Plantarum fossilium*, pp. 296, 297, and also in his treatise *De Palmis fossilibus*, contributed to the 8th fasciculus of the great work of Martius on palms, gives the subjoined summary of the number of fossil species now known, under the several classes to which they are supposed to belong.

Algæ,	119	Aquaticæ,	1
Characeæ,	6	Iulifloræ [Amentaceæ, etc.],	93
Lichenes,	1	Oleraceæ,	1
Fungi,	9	Thymeleæ,	17
Musci,	2	Contortæ,	11
Calamariæ [Equisetaceæ and Calamiteæ],	109	Nuculiferæ,	1
Filices,	444	Petalanthæ,	1
Hydropterides [Sphenophyllum],	11	Discanthæ,	1
Selagines [Lycopodiaceæ, Lepidodendreæ, etc.],	207	Polycarpieæ,	1
Zamieæ,	100	Nelumbia,	2
Glumaceæ,	11	Peponiferæ,	1
Enantioblastæ,	2	Columniferæ,	14
Coronariæ [Lilia],	13	Hesperides,	2
Scitamineæ [Musaceæ],	14	Acera,	19
Fluviales,	21	Frangulaceæ,	4
Spadicifloræ [Pandanocarpum etc.],	18	Tricoccæ,	1
Principes [Palmæ],	43	Terebinthineæ,	20
Coniferæ,	141	Calycifloræ,	5
		Myrtifloræ,	2
		Rosifloræ,	2
		Leguminosæ,	45
		Plantæ incertæ sedis,	118
		Numerus omn. spec.	1648

The *classes* here given are those adopted by Endlicher. A. Gr.

V. Astronomy.

1. *First Comet of* 1846; (L'Institut. No. 638, March 25, 1846.)—This comet was discovered Jan. 24, 1846, in the constellation *Eridanus*, by the Astronomers at the Observatory of the College at Rome. Although its light was feeble, it showed occasionally a distinct nucleus, and a small fan-shaped tail. It was observed up to March 4th, and probably somewhat later. The following approximate elements of its orbit were obtained by the Roman Astronomers.

Perihelion passage,	1846, Feb. 24·7789
Long. of Perihelion,	119° 38′ 21″
" " Asc. Node,	114 7 36
Inclination,	42 59 40
Perihelion distance,	1·37155
Motion,	direct.

2. *Second Comet of* 1846.—The comet discovered February 26, 1846, by Mr. George P. Bond, at the Observatory of Cambridge, Mass., an account of whose elements was given in this Journal, ii. Ser. i, 447, 448, had been previously detected on the 20th of that month, by the Astronomers at Rome. It was followed until about the 20th of May. Its orbit has much resemblance to that of the comet of 1707.

3. *Third Comet of* 1846.—On the 26th of Feb., 1846, Mr. Brorsen at Kiel, in Holstein, discovered a telescopic comet near η *Piscium*. Its parabolic elements computed by Mr. Petersen of Altona, are given below, by Mr. Schumacher, together with the elements of Apian's comet of 1532 referred to the ecliptic of 1846·0. Its elements agree also very nearly with those of the comet of 1661.

	Brorsen.	*Apian.*
Perihelion passage 1846, Feb. 27·4451 Berl. m. t.		Oct. 20·1532
Long. of Perihelion,	116° 25′ 12″	116° 28′
" Asc. Node,	96 21 32	92 3
Inclination,	32 34 10	32 36
Perih. distance in miles,	61,906,560	58,845,120

Prof. Encke considers this to be a comet of short period, and gives for it the following elements.

Perihelion passage 1846, Feb. 24·02410 Berl. m. t.	
Long. of Perihelion,	116° 11′ 57″·5 } M. Eqx. 1846.
" Asc. Node,	106 4 25·5 }
Inclination,	29 29 30·8
Perih. distance,	0·662
Angle of Excentricity,	45 26 9·2 = 0·71247
Log. mean dist.	0·357566 = 2·2780 Semi ax. maj.
	3·211123 Ax. min.
Mean daily motion,	1031″·95
Period,	yrs. 3·43874 = 1256 days.

4. *Fourth Comet of* 1846.—On the 15th of March, 1846, Mr. Brorsen, of Kiel, discovered near *iota Leporis*, another telescopic comet. It was very faint, and the moon just rising, prevented any accurate observation. On the 17th he thought he perceived the body in about 80° 15′ R. A., and about 13° S. decl. On the 21st at Hamburgh, M. Rümker found its place to be at $8^h\ 59^m\ 29{\cdot}6$, Ham. m. t., R. A. 88° 4′ 16″·2, and S. decl. 14° 8′ 34·6. On the 27th, at his observatory in Kensington, Sir James South observed its place to be at $8^h\ 44^m\ 11^s$. m. t., R. A. about 101° 9′, and S. decl. about 14° 35′ 2″. The comet was extremely faint, of an irregular figure, without any appearance of a nucleus, and under the most feeble illumination of the field of his five-feet equatorial, it became invisible.

5. *Fifth Comet of* 1846—*Bond's Comet.*—On the 19th of May, 1846, Mr. George P. Bond, of the Observatory of Cambridge, Mass., discovered in the constellation *Lynx*, another telescopic comet, of considerable brightness. The following approximate elements of the orbit of this comet have been furnished by Prof. Peirce, of Harvard University.

Perihelion passage,	1846, June, 4·2454	Gr. m. s. t.
Perihelion distance,	0·64612	
Inclination,	29° 16′·5	
Longitude of the Asc. Node,	264 5·9	Mean Eqx. of
" " Perihelion,	164 23·7	Jan. 1, 1846.
Angle from node to perihelion,	99 42·2	
Motion,	retrograde.	

These elements are derived from the subjoined places determined by Mr. Bond. They are referred to the mean equinox and equator of Jan. 1, 1846, and are satisfied by the foregoing elements, within five seconds of arc.

Camb. m. s. t.	R. A.	N. Decl.
1846. May $19^d\ 12^h\ 15^m\ 2^s$	$6^h\ 34^m\ 58^s{\cdot}45$	51° 31′ 6″·4
21 9 11 44	6 44 5·07	48 55 48·0
22 9 1 38	6 47 44·48	47 43 00·0

6. *Observations on the Solar Eclipse of April* 25, 1846.

1. *Burlington, N. J.* Lat. 40° 4′ 51″·6 N. Observation by Mr. Samuel J. Gummere, with refractor of 42 inches focus.

Beginning, ...	$10^h\ 48^m\ 46^s$ m. s. t.
End, ...	Sky overcast.

2. *Providence, R. I.* Observation by Prof. Caswell.

Beginning, . . .	$11^h\ 11^m\ 40^s{\cdot}5$ A. M., mean solar time.
End, ...	1 51 20 P. M.
Duration, . . .	2 39 39·5.

A separate observation by Mr. H. Rice, gave

Beginning, ...	$11^h\ 11^m\ 37^s$.
End, ...	1 51 19.
Duration, ...	2 39 42.

3. *Charleston, S. C. College.* Observation by Prof. Lewis R. Gibbes.

Beginning, ...	lost.
End, ...	$1^h\ 4^m\ 16^s{\cdot}5$.

VI. Miscellaneous Intelligence.

1. *Waves of the Atlantic and German Ocean;* by T. Stevenson, (Trans. Roy. Soc. Edinburgh, xvi, 23.)—Mr. Stevenson's experiments were made on the waves in the Irish Sea, the German Ocean, and the Atlantic at Skerryvore. To obtain results an instrument was contrived, which he calls a Marine Dynamometer. It consists of a circular plate to receive the impinging wave, which acts upon a powerful steel spring enclosed in a cylinder; and it is so arranged as to be self-registering. The following are among the results obtained, with other observations by Mr. Stevenson.

In the *Atlantic Ocean*, according to the observations made at the Skerryvore rocks, the average of results for five of the *summer* months during the years 1843 and 1844, is 611 lbs. per square foot. The average results for six of the *winter* months (1843 and 1844) is 2086 lbs. per square foot, or thrice as great as in the summer months.

The *greatest result* yet obtained at Skerryvore was during the heavy westerly gale of 29th March, 1845, when a pressure of 6083 lbs. per square foot was registered. The next highest is 5323 lbs.

In the *German Ocean*, according to the observations made at the Bell Rock, the greatest result yet obtained is 3013 lbs. per square foot.

It thus appears, that the greatest effect of the sea, which has been observed, is that of the Atlantic at Skerryvore, which is nearly equal to three tons per square foot.

These experiments, amounting to 267 in number, and on the Atlantic alone extending over 23 months continuously, are not intended to prove any thing farther than the simple fact, that the sea has been known to exert a force equivalent to a pressure of three tons per square foot, however much more. Now, when we consider that the hydrostatic pressure due to a wave of 20 feet high, is no more than about half a ton on a square foot, we see how much of their force the waves owe to their velocity. There can be no doubt, however, that results higher than this will be obtained.

I shall now contrast the indications of the Marine Dynamometer, by stating a few facts regarding the ascertained effect of the waves in the elevation of spray, and in the transportation of heavy masses of rock. This is more especially important, as to some, the results indicated by the instrument have appeared greater than they could have expected; and it has even been supposed that, were they correct, the stones which constitute our marine works would be scattered.

In the Frith of Forth, at the Granton Pier works, on 19th December, 1836, after a gale from the northeast, one stone was moved measuring

fifteen cubic feet, or about one ton in weight, and thrown on the beach, after having been built into the wall; and a stone containing 18 cubic feet was moved 30 feet from its place; while the *pierres perdues* or mound stones were washed down to a slope of about 4 to 1.

The following instance, which occurred at the landing slip of the Calf Point, Isle of Man, affords a proof of the great force of the waves even in the Irish Sea. During a gale from the northwest, a block was lifted from its place in the wall and thrown landwards, which measured 123½ cubic feet, equal to about 10 tons weight.

In the German Ocean, we can refer to the Bell Rock Lighthouse, which, though 112 feet in height, is literally buried in foam and spray to the very top, during ground swells, when there is no wind. It is, therefore, a very important station for making such experiments, because the rise of the spray may be regarded as a scale by which the results of the Marine Dynamometer can be checked or compared.

In the published account of this work there occurs the following statement:—On the 24th October, 1819, the spray rose to the height of 105 feet above the rock. "It may, perhaps, therefore," says the author, "be concluded, that the maximum force of the sea at the Bell Rock is to raise the sprays to the height of about 105 feet above the surface of the rock;" and deducting 16 feet, which is the height that the tide rises upon the tower, there is left 89 feet, as the height to which the water is raised. This is equivalent to a hydrostatic pressure of about 2½ tons on the square foot. Since that time, however, there have been still greater proofs of the force of elevation. On the 20th November, 1827, the spray rose 117 feet above the foundations or low water mark; and the tide on that day rose 11 feet upon the tower, leaving 106 feet as the height of elevation, (exclusive of the trough of the sea,) being *equivalent to a pressure of very nearly* 3 *tons per square foot.*

At the island called Barrahead, one of the Hebrides, a remarkable example occurred during a storm in January, 1836, in the movement of a block of stone, which, from measurements taken on the spot, is 9 feet × 8 feet × 7 feet = 504 cubic feet, which, allowing 12 feet of this gneiss rock to the ton, will be about 42 tons weight. This great mass was gradually moved 5 feet from the place where it lay, having been rocked to and fro by the waves till a piece broke off, which rolling down, and jamming itself between the moving mass and the shelving rock on which it rested, immediately stopped the oscillatory motion, and thus prevented the farther advance of the stone.

Mr. Reid, the principal keeper of Barrahead lighthouse, the assistant keeper, and all the inhabitants of the little island, were *eye witnesses* of this curious exhibition of the force of the waves; and Mr. Reid also

gives the following description of the manner in which they acted upon the stone.

"The sea," he says, "when I saw it striking the stone, would wholly immerse or bury it out of sight, and the run extended up to the grass line above it, making a *perpendicular* rise of from 39 to 40 feet above the high water level. On the incoming waves striking the stone, we could see this monstrous mass of upwards of 40 tons weight lean landwards, and the back run would uplift it again with a jerk, leaving it with very little water about it, when the next incoming wave made it recline again. We did not credit the former inhabitants of the island, who remarked that the sea would reach the storehouse which we were building; and when these stones were said to have been moved it was treated with no credit, and was declared by all the workmen at the lighthouse works to be impossible; yet the natives affirmed it to be so, and said if we were long here we might yet see it. They seemed to feel a kind of triumph when they called me to see it on the day of this great storm."

2. *Cotton in India;* (Athenæum, No. 964, p. 398.)—Dr. Royle communicated to the Asiatic Society on March last, a letter from Dr. Wight, relative to the progress which the cultivation of cotton is making in India, and showing a degree of success and magnitude of produce far exceeding what had been expected. He stated that 30,000 lbs. have been already gathered, and "one field, of which regular accounts are kept, has already yielded 700 lbs. per acre."

3. *Roman Coins.*—In a field in the commune of Plourhau, (Côtes-du-Nord,) the discovery has been made of an immense number of Roman coins, estimated at no less than 18,000 or 20,000. The heap weighs sixty kilogrammes. The pieces include a great variety of types—many representing mythological subjects—and are generally in good preservation. Most of them appear to present at least nineteen centuries of antiquity; and they are conjectured to have belonged to some detachment of Roman troops obliged suddenly to quit the country, who may have buried them in the hope of some day returning to reclaim them.

4. *Anthracite and Bituminous Coal in China;* by R. C. Taylor, (Phil. Mag. March, 1846, xxviii, p. 204.)—It is probable that coal was discovered, and was in common use in China, long before it was known in the western world. It is mentioned by a noble traveller of the 13th century, as abounding throughout the whole province of "Cathay," of which Pekin is the capital, "where certain black stones are dug out of the mountains, which stones burn when kindled, and keep alive for a long time, and are used by many persons, notwithstanding the abundance of wood."

The good missionaries were fully capable of describing the coals which were supplied to Pekin, since they there erected a furnace or stove, in which they experimented on the properties of those combustibles; particularly with reference to the ordinary domestic uses, and for the warming of apartments and the purposes of their laboratory.

Among the people of Pekin three kinds are in use.

1. That employed by the blacksmiths. It yields more flame than the other qualities; is more fierce, but is subject to decrepitate in the fire; on which account, probably, the blacksmiths use it pounded in minute particles.

2. A harder and stronger coal, used for culinary purposes, giving out more flame than the other sorts so employed; it is less quickly consumed, and leaves a residuum of gray ashes. There are several gradations of these. The best are hard to break, of a fine grain, a deep black color, soiling the hands less than the others. It sometimes is sufficiently siliceous to give fire with steel. Others have a very coarse grain, are easily broken and make a bright fire, leaving a reddish ash. Another species crackles or decrepitates when first placed on the fire, and falls down, almost entirely, in scales, which close the passage of the air, and stifle the fire.

3. A soft, feeble burning coal, giving out less heat than the 2nd class; consuming more quickly, it breaks with greater facility, and in general is of deeper black than the sorts previously mentioned. It is commonly this description which, being mixed with coal-dust and a fourth part of clay, is employed to form an artificial and œconomical fuel. This being moulded in the form of bricks and balls is sold in the shops of Pekin. Wagon-loads of coal dust are brought to that city for this sole purpose.

The coal merchants have also an intermediate quality between the classes 2 and 3.

We cannot in this place recite the numerous details which are furnished by these intelligent Fathers. Suffice it to add, that nearly all of the properties and applications are now in every-day use in the United States, and are familiar to all. They are, in fact, the natural results suggested by qualities possessed in common by the combustibles of remote parts of the same globe. Even the modern method of warming all the apartments of our dwellings, which we view as the result of superior practical and scientific investigation, was in use, with little deviation, centuries ago by the Chinese. Many a patented artificial fuel compound both in Europe and America, has been in practical operation in China at least a thousand years.

4. *Anthracite.*—Another description of coal abounding about thirty leagues from Pekin, but which was not then in such general use there

as the other kinds, is called by the Chinese Che-tan. Che means a stone, but tan is the name they give to wood-charcoal. Therefore, according to the genius of the Chinese language, this compound word signifies a substance resembling or having the common properties of stone and charcoal. There can be little difficulty here in recognizing the variety of coal which in our day has been denominated anthracite, a compound word of similar meaning.

The Chinese *glance coal* forms a remarkable exception to the unfavorable conclusion prevailing against Oriental coal; and, according to more recent authority than those we before cited, deserves to rank at the head of the list, in respect to its purity as a coke, although in specific gravity it does not come up to the character of the Pennsylvania or Welsh fuel; neither has it the spongy texture which contributes much to the glowing combustion of the latter.

So late as 1840, a Russian officer described the coal formations of the interior, as occupying the western mountain range of China, in such abundance that a space of half a league cannot be traversed without meeting with rich strata. The art of mining is yet in its infancy among the Chinese; notwithstanding which, coal is thought to be at a moderate price in the capital. Anthracite occurs in the western range of mountains at about a day's journey, or thirty miles only, from Pekin. The coal formation is largely developed, in which thick beds of coal occur. They appear to be of various qualities. Some of this coal, occurring in shale beds, is singularly decomposed, and its particles have so little cohesion, that they are almost reduced to a state of powder. Beneath these coal shales are beds of ferruginous sandstone, and below those occur another series, consisting of much richer seams of coal than the upper group.

Coal in other parts of China.—The Missionaries and others inform us that coal is so abundant in every province of China, that there is perhaps no country in the world in which it is so common. The quays at Nankin are stored with the finest native coal. Some of the coal which was brought down to the coast, from the Pekin country, to the Gulf of Pe-tchee-lee, was anthracite, partaking of the character of plumbago or graphite. Coal, apparently of the brown coal species, exists extensively in the direction of Canton; while all the coals seen on the Yang-tse-kiang river, south of Nankin, resembled cannel coal. Nearer to Canton it possessed the comparatively modern character of the brown coal. It was abundantly offered for sale in the different cities through which Lord Amherst's embassy passed, between the lake Po-yang-how and Canton, and the boats were largely supplied with it. It is there obtained by means of pits, like wells; and we infer that,

like nearly all the brown coal deposits, the beds were horizontal, and at no great depth. A sulphurous coal, interstratified with slate, and in the vicinity of red sandstone, also prevails towards Canton.

5. *Chair of Anatomy at Edinburgh;* (from the Ann. Mag. Nat. Hist. for May, 1846.) We are happy to hear that Mr. John Goodsir has been elected to the important office of Professor of Anatomy in the University of Edinburgh. The original and highly philosophical essays of that gentleman have gained him an European reputation as an anatomist and physiologist, whilst his services in the cause of natural history have placed him in an equally high position as a biologist. His memoirs on the *Amphioxus* and *Orthagoriscus*, on the anatomy of many mollusca, radiata, and entozoa, and on certain vegetables parasitic on animals, are familiar to the readers of the 'Annals.' Anatomy and natural history will equally gain by this excellent appointment.

6. *Association of Geologists and Naturalists.*—This Association holds its next annual session in the city of New York in September, commencing with the 2d of the month. Dr. C. T. Jackson will preside as Chairman of the meeting. A list of the officers and the standing and local committees, will be found on our advertising sheet.

7. *Officers of the American Academy for the Current Year.*—Jacob Bigelow, M. D., *President;* Hon. Edward Everett, LL.D., *Vice President;* Asa Gray, M. D., *Corresponding Secretary;* Oliver W. Holmes, M. D., *Recording Secretary;* J. Ingersol Bowditch, *Treasurer.*

8. *Concord Natural History Society.*—The Concord (New Hamp.) Natural History Society has commenced with much zeal, and we trust that it will receive the favor and substantial patronage of the intelligent community among whom it is established. At the first meeting in April, the following persons were chosen as officers for the ensuing year:—Dr. Wm. Prescott, *President;* Hon. N. G. Upham, Paul Wentworth, Esq., *Vice Presidents;* Wm. Kent, Esq., *Recording Secretary;* Asa Fowler, Esq., *Corresponding Secretary;* I. F. Williams, Esq., *Treasurer;* Wm. C. Prescott, *Librarian and Cabinet Keeper;* Dr. T. Haynes, Dr. C. P. Gage, Richard Bradley, Esq., Abiel Chandler, *Managers.*

Obituary.—*Died*, on the 5th of May last, at Boston, the Hon. John Pickering, an eminent counsellor and an equally eminent scholar. The bar of Suffolk County, in a commemorative resolution, say—"His learning, the accumulation of a long life of study, embraced nearly every branch of human knowledge, without omitting any part of what

was appropriate to his profession. His fine powers and great accomplishments were adorned by a native modesty, which attracted the most enduring confidence of his fellow men. His rare and cultivated taste, his kind and gentle manners, his fidelity to every relation, his laborious diligence, his public services, his profound scholarship, his pure and spotless nature are honored on this mournful occasion, by his brethren, as they will long be cherished by the whole community." We have only to add to this very just delineation, our deep personal regret, from a friendly intercourse of several years.—B. S.

Death of Bessel.—Frederick Wm. Bessel, one of the most celebrated astronomers of the age, died after a most distressing illness, at Königsberg, in Persia, on the 17th of March, 1846, in the 62d year of his age.

Deceased Members of the Royal Society.—The anniversary address of the president furnishes us with the names of several distinguished men, who have deceased during the past year.

Dr. William Heberden, a distinguished author on Hygiene; he died on the 19th of February, 1845, aged 77.

John Frederick Daniell.—We have already noticed the death of Prof. Daniell, which took place on the 13th of March, 1845, by a fit of appoplexy, at the age of 55, having been born in London 12th March, 1790. It is a remarkable proof of the variety and extent of Mr. Daniell's acquirements, that he received at different times, all the medals in the gift of the Royal Society.

Jaques Dominique Cassini, Comte du Thury, at the age of 97. He was the fourth in direct descent of a family, which, during nearly two centuries, has been singularly illustrious in the history of the sciences, and particularly of astronomy. He was the fifth of his family who had been elected a member of the Académie des Sciences.

Théodore de Saussure of Geneva, son of the celebrated Alpine traveller, and an illustrious vegetable physiologist, botanist, and meteorologist. He died April 18, 1845, aged 78.

Bibliography.

1. *Synopsis of the Fishes of North America;* by D. Humphreys Storer, M. D., A. A. S., &c. (4to. Cambridge, pp. 298.)—This work was prepared in answer to a call from the Association of American Geologists and Naturalists, for a paper on the "Comparative Ichthyology of North America and Europe," and was read to that Association at their meeting in New Haven, May, 1845. Subsequently it was presented to the American Academy of Arts and Sciences for publication, and constitutes one of the papers of the volume of their transactions, just from the press.

We look with no little gratification upon this addition to American Zoölogical literature, by an American naturalist. Both the design and the execution are most happy. When it was undertaken, no work embodied descriptions of any considerable portion of North American fishes. Since then, the labors of Dr. Dekay have, in some measure, supplied this deficiency. Nevertheless, a compact work, which might be readily consulted, exhibiting at one view a list of all the fishes that have been noticed, a concise description of them, and references to figures and more full descriptions, and whatever had been published concerning them, was just the thing wanted; and it was something which could not be effected without great research and labor. This has now been accomplished, by untiring perseverance, during hours stolen from severe professional duty, under much physical disability as we happen to know, and in a manner which reflects great credit upon its author.

No one who has not undertaken thus to gather in, from volumes in various languages, from scientific and literary periodicals, and even from newspapers, the scattered descriptions of objects, then plotting them out into a harmonious whole, and thus opening a fair field on which future investigations may rest, can have a just idea of the labor requisite. In the present instance we notice that not less than seventy-five different volumes, many of them rare and difficult of access, have been consulted. Dr. Storer has thus placed this little library in the hands of every student of American ichthyology. Nothing tends more to throw a chill over the ardor of inquiry, than the apprehension that we may be laboring upon what is already understood, or the consciousness that we have no means, without disproportionate labor, of gaining satisfaction on the point. On the other hand, nothing tends more to encourage the solitary inquirer than the conviction, that whatever he observes which is not noticed in a certain book before him, is pretty sure to be novel. In spite of the want of facilities, ichthyology, like the other branches of zoölogy, has already many worthy votaries among us, as the names of Dekay, Holbrook, Kirtland, Ayres, Olmsted and Storer, will attest. But we may now safely predict that the work before us will bring out an army of recruits, who, by possessing themselves of the scientific treasures about them, will speedily augment greatly the list now published.

Dr. Storer's list enumerates 741 species, belonging to 221 genera and 35 families. In it are included all the fishes that have been noted as inhabitants of all the waters which wash the coast of North America, the south and west as well as the north and east. The character of each family, genus and species are given, with the localities of the last, and the authority for the localities, and also a very full list of synonyms. The descriptions of all the fishes which have been seen by

Dr. S. are made out in his own terms; the others have been translated or abridged, as the case required, from the language of the original describers. Besides the descriptive portion there are also several interesting tables relating to the geographical distribution of the fishes. These show those *genera* which are found both in Europe and America—those found in North America and not peculiar to it, but not found in Europe—those peculiar to America—those found in North, and extending to South America. Again, we have tables of the *species* found both in Europe and North America—of those extending from North into South America—and of those peculiar to the North-West Coast.

We think of nothing, that could render the work more valuable as a manual, except that it were published in a manner to admit of its more extensive diffusion among actual laborers.

2. *The Naturalist, and Journal of Agriculture, Horticulture, Education and Literature;* conducted by I. N. Loomis, J. Eichbaum, J. S. Fowler, and T. Fanning, at Franklin College, Tennessee, in monthly numbers of 48 pages.—The first number of this monthly journal was issued in January. It is devoted to the dissemination of information on science and its applications, and to useful miscellaneous intelligence, besides original articles in natural history. The number for March contains a catalogue of the fluviatile shells of the family Naiades of Jefferson Co., Ky., by B. F. Shumard, M. D., of Louisville; also remarks on the Geology of Harpeth Ridge, Davidson Co., Tennessee.

3. *Elements of Physiology, including Physiological Anatomy, for the use of the Medical Student;* by Wm. B. Carpenter, M. D., F. R. S., &c., &c., (Lea & Blanchard, Phil. 1846; 8vo. pp. 566—180 cuts.) —Dr. Carpenter is so well known in this country to all physiological and medical readers, by his several works on general, human, and vegetable physiology, that no comment is required from us on the present work, which covers some of the most interesting branches of the wide domain of physiology. This author is not merely the compiler of other men's ideas, (although every elementary author must be so to some extent,) but he is among the most active investigators in his science, in Great Britain. His recent researches on the microscopic structure of shells, are before the world in the last volume of the reports of the British Association, and a notice of his important discoveries may be found in this Journal, ii. Ser. i, 283. The work is arranged and adapted for the elementary use of the student of medicine, and is thoroughly brought up to the day.

4. *American Quarterly Journal of Science, conducted by* E. Emmons and A. Osborne, Esq. Albany: $2 per annum.—The third volume of this agricultural journal has been completed, and it sustains the high

character of the previous volumes. The sciences of agriculture and mining, subjects of great importance to the state of New York and to the whole country, are presented in a full and yet popular manner. No. 1 of vol. III, contains, besides other original articles, an account of the copper mines of Lake Superior, with a map; a report on the resources of Orange county for manures; on salt as a fertilizer: and No. 2 of the same volume, presents its readers with a memoir on the agricultural geology of Onondaga county, with many analyses of soil and rocks; an article on Irish agriculture; another on European agriculture; an account of the Zeuglodon with figures of several bones. Besides these and other memoirs, there are copious excerpts of agricultural and scientific interest.

4. *Manipulations in the scientific arts:* 1. *Photogenic Manipulation*, in two parts; by G. T. FISHER, Jr. 2. *Electrotype Manipulation*, in two parts; by C. V. WALKER. Small 18mo. pp. 110 and 150. Reprinted from the London edition. Philadelphia: Carey & Hart.

These useful little treatises are timely, and cannot fail to promote an intelligent application of science to the arts, in two of the most remarkable and useful discoveries of modern times.

5. *Turner's Chemistry*, 7th edition, with notes and additions; by JAMES B. ROGERS, M. D., and ROBERT E. ROGERS, M. D. Phil. 1846. Thos. Cowperthwaite & Co. 8vo. pp. 848.—A new edition of Dr. Turner's Elements was much needed in this country: it has had a most deserved popularity here as well as in England, as one of the best treatises on elementary chemistry which has ever appeared. The present edition has been brought down to the present time by a number of judicious notes added by the Messrs. Rogers.

6. *Monthly Miscellany and Journal of Health;* edited by W. M. CORNEL, M. D., $1 per annum.—This journal was commenced the 1st of January last. It contains much good reading, and valuable intelligence, and information on health, of a popular character.

7. *A History of British Fossil Mammals and Birds; by* RICHARD OWEN, F. R. S., F. G. S., etc. *Illustrated by* 237 *wood cuts.* London: J. Van Voorst, Paternoster Row. 1846. 8vo. pp. 560.—This volume is one of a uniform series of works, publishing in London by Mr. Van Voorst, comprising a complete zoology of the British Islands. Mr. Owen's late labors, undertaken at the request of the British Association for the advancement of Science, on the remains of British fossil vertebrate animals, have peculiarly fitted him for the present task. The chapter on the Proboscidian animals we have read with peculiar interest. The beautiful figure of the *Mastodon giganteus*, at p. 132 of this volume, is a fac simile of that given by Mr. Owen, and is a fair sample of the high style of art in which all the wood cuts of this volume are

finished. *Such* figures worked into the page, quite supersede the necessity of more costly and less convenient copper plates.

The introduction to the present volume must be read with delight by all who feel any interest in the past history of our globe, as drawn from organic evidences. We shall take pleasure, as far as it may be practicable, in making from this chapter and other parts of this 'History,' such extracts and abstracts as will be most likely to interest our readers.

8. *Thoughts on Animalcules, or a Glimpse of the Invisible World revealed by the Microscope;* by GIDEON ALGERNON MANTELL, Esq., LL. D., F. R. S., &c. 1846.

Notes of a Microscopic Examination of Chalk and Flint; by the same Author. 1845.

The wonders revealed by the microscope are becoming every day more interesting and instructive. At the head of the works on this subject, stands Ehrenberg's magnificent folio, illustrated by sixty-four colored plates.

"The reader who has not seen this work, can have no adequate idea of the fantastic shapes, and the almost endless variety of form and structure which animal existence assumes, even in our own planet, in the regions from which the microscope withdraws the veil."

The Thoughts on Animalcules of Dr. Mantell are contained in a beautiful little volume of 144 pages, containing twelve exquisitely figured and colored plates of living animalcules, drawn from nature and greatly magnified. This work is in keeping with all others of the same distinguished author, not only in eloquence of thought and diction, and in minuteness and accuracy of research, but in the minor excellencies, of paper, print, and binding.

Excellent microscopes are now prepared in London and Paris at prices within the reach of most literary and scientific institutions, and of many individuals, by which the wonders he describes may be easily demonstrated from specimens found in almost every pond and pool of water. The principal divisions of the work are—

1. The ideal invisible world. 2. The invisible world revealed by the microscope. 3. The Hydra or fresh-water polype. 4. The divisibility of vitality. 5. Cells the essential organs of life. 6. The Infusoria or fresh-water animalcules. 7. The Polygastria. 8. The Monads. 9. The Vorticellina or bell-shaped animalcules. 10. The Rotifera or rotating animalcules. 11. The Floscularia or flower-shaped animalcules. 12. Stephanoceros or crowned wheel animalcule. 13. The Rotifera or wheel animalcule. 14. Animalcules with durable cases or shells. 15. Reflections. 16. General Remarks, Conclusion, Appendix, Notes, &c.

The principal value of the work is in prompting observation and rendering the objects accessible in common circumstances, to all persons who can have the use of a microscope of considerable power. Thus they will become convinced that where nothing is seen by the naked eye, or at most a scum or a slight cloudiness or a little jelly-like matter adhering to immersed vegetables, there are often forms of exquisite structure and beauty, some of which are little more than mathematical points, but possessing all the organs necessary to their existence and functions. A world is thus revealed to our view of whose existence we have ordinarily no evidence.

In treating of *Final Effects*, the author expresses his decided conviction "that no well regulated mind can rise from the contemplation of the marvels revealed by the microscope, without being so deeply impressed with a sense of awe, of humility, and of dependence, as to be secured from the arrogance and presumption of attempting to interpret the final purposes of the ETERNAL, even in the minutest of his works. We may indeed take cognizance of some of the obvious results of the operations of these living atoms; such for instance as their influence in maintaining the purity of the atmosphere and of the water, by the conversion into their own structure of the particles liberated by the decomposition of the larger animals and vegetables; and in their turn becoming the food of other races, and thus affording the means of support to creatures of a higher organization than themselves. We see too that many species after death give rise to the formation of earthy deposits, at the bottom of lakes, rivers, and seas, which in after ages may become fertile tracts of country and the sites of large communities of mankind."

The Notes on the Microscopic Examination of Chalk and Flint, are highly interesting and instructive, and fully support the conclusion, that animalcules, corals, and foraminifera or polythalmia have been largely concerned in these formations, and that thermal or hot water rendered potent in dissolving silica by the aid of heat and pressure and alkalies in solution, has been efficiently operative in the solidification of organic bodies, and an appeal is carried up to operations of nature now going on under our eyes, and to the results of actual experiment, which can leave no doubt that the principal, although it may not be the exclusive cause of silicification, is that just indicated.

9. *Harvey's Phycologia Britannica.*—Of this work, which was barely announced in the bibliography of our last number, the following notice has appeared in the London Journal of Botany for May last:—

"Four numbers of this beautiful work are already before the public, and the judgment of that public has been pronounced upon it. We believe of its merits there can be but one opinion, viz. that at no period

of botanical literature has a more important contribution been made to the Flora of the British Isles than on the present occasion. Of Dr. Harvey's fitness for the descriptive portion of the work, a moment's doubt could not be entertained; but it adds infinitely to the value of the plates to know that not only are the drawings and analysis all executed by Mr. Harvey's own hands, but the plates (lithographs) also; thus ensuring the most perfect accuracy to the figures as well as the letter-press. The work will be completed in sixty numbers, and each number contains six colored plates at the moderate price of 2*s.* 6*d.* These appear without reference to systematic order, but at the conclusion of each volume, and more fully at the completion of the entire work, systematic and alphabetical indexes will be added; and finally a general introduction, to be prefixed to the last volume, will complete the history. The plates represent the natural size of magnified dissections of the species, accompanied by generic and specific characters, synonyms, British habitats, the geographical distribution and general history of each individual, in a fuller and more perfect manner, than has yet been attempted in any work exclusively devoted to the illustration of British Algæ."

In Great Britain the sea-weeds have long been favorite objects of study, and are perhaps as well known as many tribes of phænogamous plants; while with us they have been almost universally neglected. We hope that this neglect will not continue. Our species, especially those of our northern shores, being mostly the same as those of the north of Europe, this work of Dr. Harvey, and his former Manual of British Algæ, will do much to facilitate their study with us, in default of native writings on this branch of botany. To call attention to the subject, and to show how easily persons of leisure, who reside upon or visit the coast, may render essential assistance to those specially occupied with this department, we venture to copy a portion of a private letter of Dr. Harvey's soliciting such collections:—

"I have in contemplation other illustrated works on the foreign species, and am therefore very desirous of specimens from all parts of the world. From North America I have nothing! except a few from the west coast. Your long line of coast must contain many good things. They are easily dried, and make very pretty objects especially admired by *lady botanists*. Have you none of this class in America, who would like the amusement of picking sea-weeds on the shores? Here we have many, and some of our best observers are ladies. Good-natured persons who will merely visit the shore and pick up by handsfull whatever is seen; dry them like hay in the sun, without washing; pack them roughly when dry in a common packing case, and forward them in this state to Europe, will do us at this side the water an essen-

tial favor. Such collections, if made with a very slight degree of care, so as to ensure a variety of species, and especially from your southern states would be very acceptable. The best time for collecting is at spring tides, when many species can be reached which are otherwise covered. The best kind (as a general rule) grow nearest *low-water mark* and beyond it."

It will give the writer of this notice great pleasure to forward to Dr. Harvey such collections of our Algæ as may be entrusted to his charge, and to return sets authentically named to those who are desirous of making these exquisitely beautiful plants the subject of scientific study.

A. Gr.

10. Lindley's *Vegetable Kingdom, or the Structure, Classification and Uses of Plants, illustrated upon the Natural System*, (London, 1846, pp. 908, 8vo., with upwards of 500 illustrations,) is, as it were, an enlarged and greatly modified edition of this author's former *Introduction to the Natural System of Botany*. We propose to offer a somewhat detailed notice of it in the next number of this Journal.

A. Gr.

11. Martius, *Genera et Species Palmarum.*—The 8th fasciculus of this splendid work, published last September, has come to hand. It comprises, 1st, the concluding sheets of the systematic portion; 2d, a full account of Fossil Palms, by Prof. Unger, of Gratz, who, by the way, has recently published, at Leipsic, a *Synopsis Plantarum Fossilium*, in a single 8vo. volume, which will be very useful to geologists; and 3d, a dissertation on the growth and morphological structure of Palms, by Prof. Von Martius himself. His conclusions respecting the structure and growth of the palm-stem, differ materially from those of Desfontaines, De Candolle, as well as from the view of Gaudichaud, but are nearly in accordance with the views recently maintained by Misbel, in his memoir on the date-palm, &c. A. Gr.

12. *The Geology of Russia in Europe, and the Ural Mountains;* by Sir R. I. Murchison, Prest. Lond. Geol. Soc. &c. &c.; Edouard de Verneuil, Prest. Geol. Soc. of France, &c. &c.; and Count Alexander Von Keyserling, Gent. of the Chamber of H. I. M. Nicholas 1st: in two volumes 4to. Vol. I. *Geology*, (in two parts) by Mr. Murchison, pp. 700, with geological maps, sections, and numerous illustrations. Vol. II. (part third, in French,) *Palæontology*, by MM. Verneuil and Count Keyserling, pp. 512, with 50 plates of fossils; published at London and Paris, 1845. (Price in London, £8.)

These invaluable volumes appeared in London in January, and a copy some time since reached us, by the liberality of Sir Roderick Murchison and Mr. Verneuil. The distinguished author of the "Silurian System" needs no praise at our hands; and his not less distinguished

associates have ably coöperated, by their united labors and sacrifices, to raise this lasting monument, worthy of their own fame and of Imperial liberality. As may be seen by the title, Mr. Murchison is the author of the first volume, which embraces the structural geology, not only of the wide extended horizontal steppes of central Russia, from which Mr. Murchison has formed the "Permean" system; but also the complex hypogene rocks of the Uralian Mountains, stretching from north to south over 16° of latitude, and forming the eastern barrier of Europe. All this is drawn out in lucid detail and fully illustrated by excellent geological maps and sections. The pencil of Sir Roderick has also illustrated his eloquent text, by numerous lithotints of characteristic and picturesque scenes. Within the space of a bibliographical notice no adequate idea can be given of even the general scope of this noble work. But we have in the present number,* given abstracts of some topics, and shall, as opportunity offers, continue to cite such passages as may be most interesting to our readers.

The second volume, in French, by M. Verneuil and Count Keyserling, is entirely devoted to a description of the numerous palæozoic fossils, with the most admirable lithographic drawings of each species. A general '*coup d'œil*' of the paleozoic fauna of Russia is prefixed to this volume, the whole of which must be of the greatest moment and interest to American geologists, a large portion of whose domain so much resembles (in its paleontology) the steppes of Russia—both being rich in the peculiar forms of the Silurian era.

The general interest in these volumes is much increased at the present moment, by the recent arrival in the United States of M. VERNEUIL, one of the authors, who will pass the summer in making a rapid reconnaissance of our ancient fossiliferous deposits. We feel assured that, wherever his researches may take him, he will find those whose familiarity with our fossils will be equaled only by the satisfaction they will feel, in making known their results and displaying their collections to a distinguished savant, whose familiarity with paleozoic geology is at least as great as that of any living authority. M. Verneuil, as acting president of the Geological Society of France, is virtually the representative of European geology; but we are sure that this official distinction is not necessary to secure him those useful and agreeable attentions, which his affability and manly frankness will so well repay.

LIST OF WORKS.

Catalogue of the Plants of Lewis County, N. Y.; by F. B. HOUGH, A. B., published by the Senate of the State of New York, (from the Report of the Regents of New York, 1846.)

* See notices of Gold, Platina and Diamonds, on pages 119 to 123.

Fifty-ninth Annual Report of the Regents of the University of New York, made to the Legislature, March 1, 1846. 283 pp. 8vo. *Albany*, 1846. Contains full meteorological reports for the year, from the several school districts of the state.

Monographie des Coléoptères subpentamères de la Famille des Phytophages, by M. Th. Lacordaire. *Brussels and Liepsic*, 1845.

Danmarks Fiske, by Henrik Kröyer. *Copenhagen*, 1845.

Abbildungen und Beschreibungen neuer oder wenig gekannter Conchylien, A. Philippi. *Cassel.*

Horæ Tergestinæ, oder Beschreibung und Anatomie der im Herbste 1843 bei Triest beobachteten Akalephen, von J. G. F. Will. *Liepzig.*

Taylor's Scientific Memoirs, part xv, containing—*Biot*, on the employment of polarized light; *Neumann*, on a photometrical method of estimating the intensity of light; *Köne*, on the nature of aqua regia, and on the constitution of hyponitric acid; *Riess*, on the incandescence and fusion of metallic wires by electricity; *Doré* on the periodical variations in the pressure of the atmosphere.

Treatise on the Oscillations of the Barometer, with particular reference to the meteorological phenomena of November 1842, by W. Brown, Jr. *London.*

Bryologia Europæa, by Bruch, W. P. Schimper and Th. Gümbel. *Stuttgart.*

Sur le Climat de Belgique, A. Quetelet. 4to. *Brussels*, 1845.

Iconografia della Fauna italica, C. L. Buonaparte. Folio, *Vienna.*

Iconographie der land- und süsswasser Mollusken, E. A. Rossmassler. 4to. *Dresden*, 1845.

Grundzüge der Kristallographie, J. Müller. 8vo. *Brunswick*, 1845.

Traité complet de Minéralogie, by A. Dufrénoy. Three large volumes in 8vo. *Paris*, 1845, 1846.

Geschichte der Chemie, H. Kopp. *Brunswick*, 1845.

Handwörterbuch der reinen und angewandten Chemie, by Liebig, Poggendorff, and Wöhler. *Brunswick*, 1845.

Annuaire de Chimie, E. Millon and J. Reiset. 1 vol. 8vo. *Paris*, 1846.

Leçons d'anatomie comparative, tome viii, contenant les organes de la génération et des sécrétions; par Georges Cuvier et G. L. Duvernois; 2nd ed., 1 vol. 8vo. *Paris*, 1846.

De Candolle's Prodromus, vol. x; embracing the Boragineæ proper, by the late De Candolle, revised and completed by his son; the Hydroleaceæ, by Choisy; the Scrophulariacea, by Mr. Bentham; with a full index of the genera and synonyms of the whole ten volumes of the Prodromus. *Paris*, April, 1846.

SCIENTIFIC RESEARCHES.

Memoirs of the American Academy of Arts and Sciences, Cambridge, vol. ii, new series. Page 1. An account of the Magnetic Observations made at the Observatory of Harvard University, Cambridge, by Joseph Lovering, and W. Cranch Bond, A. M.

Page 85. An account of the Magnetic Observations made at the Observatory of Harvard University, Cambridge. Communicated by Joseph Lovering.

Page 161. On the practice of Circummeridian Altitudes at Sea or on Shore. By Captain W. F. W. Owen, R. N.

Page 183. The latitude of the Cambridge Observatory, in Massachusetts, determined from Transits of Stars over the Prime Vertical observed during the months of December, 1844, and January 1845, by Wm. C. Bond, Major James D. Graham, and George P. Bond. By Benjamin Pierce.

Page 205. On the Language and Inhabitants of Lord North's Island in the Indian Archipelago; with a vocabulary. By John Pickering, President of the Academy.

Page 248. A vocabulary of the Soahili Language, on the eastern coast of Africa; by Samuel K. Masury. Communicated by Charles Pickering, M. D.

Page 253. A synopsis of the Fishes of North America. By David Humphreys Storer, M. D.*

Proceedings of the Boston Society of Natural History.†—1845, vol i, p. 1. Species of new shells from Jamaica; C. B. Adams; (*genera*, Marginella, Erato, Mitra, Columbella, Buccinum, Purpura, Fusus, Pleurotoma, Cerithium, Rissoa, Eulima, Chemnitzia, Monodonta, Turbo, Scalaria, Nerita, Neritina, Fissurella, Patella, Chiton, Perna, Arca, Cardita, Thetis, (n. gen.) Lucina, Amphidesma, Tellina, Psammobia, Cyclostoma, Helicina, Truncatella, Pedipes, Succinea, Bulimus, Achatina, Cylindrella, Pupa, Helix, Paludina, Melania, Planorbis.)—Page 18. New shells from the Sandwich Islands; Dr. J. W. Mighels; (*genera*, Helix, Helicina, Pupa, Bulimus, Partula, Achatina, Achatinella, Succinea, Physa, Paludina, Sigaretus, Solarium, Turbo, Cerithium, Pleurotoma, Triton, and Cypræa, including 51 species).—Page 26. New shells from the Sandwich Islands; A. A. Gould; (*genera*, Achatina, Stomatella, Trochus, Columbella, Cypræa, Achatinella; 12 species.)—Page 33. On the Infusoria of the Mississippi; J. W. Bailey.—Page 37. New shells from Liberia, west coast of Africa; A. A. Gould; (*genera*, Pholas, Psammobia, Tellina, Nucula, Nassa, Helix; 7 species.)—Page 47. New species of fish (Etheostoma cœrulea) from Chicago, Mich.; D. H. Storer.—Page 48. New species of fish from Alabama; D. H. Storer; (*species*, Leuciscus croceus, L. prolixus, L. obesus, L. gibbosus, Etheostoma tessellata, E. cinerea.)—Page 49. New species of fish from Ohio, (Exoglossum dubium,); J. P. Kirtland.—Page 51. New species of fish (Pœcilia olivacea,) from Alabama river; D. H. Storer.—Page 53. Two new Unios from the everglades of Florida; A. A. Gould.—Page 55. New genera and species of Plants; A. Gray and G. Engleman; (new genera, Thysanella and Brazoria, and several new species.)—Page 57. On the native and black oxyd of Copper of Lake Superior and their formation; C. T. Jackson.—Page 59. Two new species of Linguatula; J. Wyman.—Page 59. On the existence of the sack of the dart, and of the dart, in several species of North American pneumobranchiate Molluscs; J. Leidy.—Page 60. On the Mastodon giganteus of Schooley's mountain, N. J.; C. T. Jackson.—Page 65. On the so-called Hydrarchos Sillimani; J. Wyman.—Page 73. A new Syngnathus (S. Californiensis) from California; D. H. Gould.—Page 74. Trochilus yucatanensis, a new humming bird; Dr. Cabot.—Page 76. Leptocephalus Morrisii, a new species of fish; D. H. Storer.—Page 77. Prionotus pileatus, a new species of fish; D. H. Storer.—Page 78. Argyreiosus unimaculatus, a new species of fish; J. M. Batchelder.—Page 79. On the cochlea of the Zeuglodon, also on boulder trains in Berkshire; H. D. Rogers.

1846, *February* 4, page 98. New species of shells from Tavoy, A. A. Gould; (*genera*, Helix, Bulimus, Pupa, Succinea, Melania, Amnicola, Nucula; in all 9 species.)—Page 101. New Bulimus from Brazil; A. A. Gould.—Page 102. New shells from Jamaica, by C. B. Adams; (*genera*, Planorbis, Cyclostoma, Helicina, Pupa, Lima; in all 5 species.)—*February* 18, page 103. Synopsis of the fishes of the state of Ohio; D. H. Storer.—*March* 4, page 106. Esox lucius, from Lake Champlain and Connecticut river; D. H. Storer.—Page 107. On Damourite from Chesterfield, and Pyrrhite from the Azores; J. E. Teschemacher.—Page 109. On fluate of lime in cannel coal; H. D. Rogers.—Page 110. On the mines of Lake Superior; C.

* A notice of this memoir is given on p. 145 of this volume.

† The brief review of the Proceedings of American Societies, here commenced, will be continued in regular series, in the following numbers of this Journal.

T. Jackson.—*March* 18, page 115. A new genus of plants, Darbya, of the order Santalaceæ; Asa Gray.—Page 118. On the supposed identity of the Anas penelope and A. americana, and on the structure of the Tetrao cupido; S. Cabot, Jr.

Proceedings of the Academy of Natural Sciences of Philadelphia, vol. iii, 1846. *February* 24, page 19. New Devonian, Tertiary, Silurian and Carboniferous fossil shells; T. A. Conrad; (*genera*, Cerithium, Tellina, Eulima, Odostomia, Delphinula, Bulla, Bonella, Calyptræa, Myodora, Ampullaria, Cancella, Cyathophyllum, Turbinolia, Madrepora, Monotis, Avicula, Strophomena.)—Page 23. New recent shells from Florida; T. A. Conrad; (*genera*, Cyrena, Venus, Nucula, Modiola, Astarte, Osteodesma, Solecurtus, Lucina, Corbula, Pallia, Murex, Marginella, Oliva, Trochus, Bulla, Crepidula, Dentalium.)—*March* 3, page 33. A fossil Asterias, with a figure, from Cincinnati, Ohio; Prof. Locke.—Page 34. On the difference of level between the waters of the Gulf of Mexico and those of the Atlantic; E. Harris.—Page 41. On the fossil Squalidæ of the United States, (37 species); R. W. Gibbes.—Page 44. On the Birds of Upper California; W. Gambel.

Annals and Magazine of Natural History, *April*, 1846, No. 112. On the Tribe Spheriaceæ and descriptions of new genera; G. de Notaris.—On the genus Sitona, (Curculionideæ); J. Walton.—On the British Rubi; C. C. Babington.—Embryogeny, &c. of the simple Ascidians; M. Van Beneden.—Development of Chara; C. Müller.—On the occurrence of Tetraspores in Algæ; G. H. K. Thwaites.—New genus (Cynalicus) of Dogs; J. E. Gray.—Linnæan Society, June 17. New Chalcidites; F. Walker.—Entomological Society, Nov. 4. A new locust; F. W. Hope.—Entomological peculiarities of New Zealand.—Zoological Society, Oct. 14. On the genus Anous; J. Gould.—Two new birds from New South Wales; J. Gould.—New Ostreæ; S. Hawley.—New species of Murex; L. Reeve.—New species of Nerita, from Cumming's collections; C. A. Recluz.—*May* 1846, No. 113. New genus of Gasteropods; G. J. Allman.—On the British Rubi; C. C. Babington.—Development of Chara; C. Müller.—New Homopterous insects in the British Museum; A. White.—Species of Semnopithecus from Malacca; T. Cantor. Linnæan Society, Nov. 18. Anatomy of a Meloë; J. Newport.—Plants of the Gallipagos Islands; J. D. Hooker. Zoological Society, Oct. 28. New Neritæ, from Cumming's collections; C. A. Récluz.—New Pleurotomæ, from Cumming's collections.

Archiv für Naturgeschichte, No. iii, 1845. Synoptical table of Entozoa continued; von Gurlt, with an appendix by M. Creplin.—Review of works and memoirs on Mammalia, of the year 1844; A. Wagner.—Review of works and memoirs on Birds, for the year 1844; A. Wagner.—No. iv, 1845. Cryptorhynchus Lapathi, with a plate; Prof. Schwägrichen.—New Echinoderms, with a plate; A. Philippi.—Appendix to a Conspectus of birds, by J. J. von Tschudi.—Review of works and memoirs on Insects, Arachnida and Crustacea, for the year 1844; W. F. Erichson.

Bulletin of the Royal Academy of Berlin, (Bericht, &c.) November 1845. New Polygastrica and Polythalamia, with some new genera; Hr. Ehrenberg.

Isis, (Leipzig,) No. i, 1846. Review of European Lepidoptera; C. F. Freyer.

Verhandlungen der kaiserlich leopoldinisch-carolinisch Academie, vol. xxi, 1845. On Regelia, Beaufortia and Calothamno, genera of Myrtaceæ; J. C. Schauer.—Elatinarum Monographia; M. Seubert.—On the Mosasaurus Maximiliania; A. Goldfuss.—Spermatozoa of the Locustineæ; C. Th. von Siebold.—Microscopic examination of the liver and its secretions of Crustacea and Mollusca; H. Karsten.